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# THE PICTURE OF VERY EARLY CARCINOMA OF THE UTERINE CERVIX

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FROM a study of the so-called "precancerous" and early malignant lesions of the cervix, Pemberton and Smith concluded that in a given specimen the presence or absence of cancer could be determined quite definitely and that the finding of "precancerous" characteristics did not necessarily indicate that cancer would develop later. On the contrary, the evidence pointed more to the view that early carcinoma may develop in apparently normal epithelium and spread superficially before invading, and that the "precancerous" areas as often as not were stages in a healing process, e.g., hyperkeratosis following infection or mechanical trauma. Others have emphasized the inaccuracy of the term "precancerous," and recently Schiller has again pointed out its ambiguity, since it can be interpreted as meaning either that cancer may be the outcome or that the disease surely will follow. Further, he has demonstrated what he is led to believe are the characteristics of very early malignant disease of the cervix. In 1921, Cullen reported and profusely illustrated an early cervical cancer similar to those described by Schiller.

The object of this communication is to describe and depict 16 cases in which we independently have diagnosed early cancer of the cervix on the basis of our own experience. These cases, we have found, resemble those of Cullen and Schiller. That others may not concur with us in our diagnoses we are well aware, since generally the pathologists to whom we have submitted sections for confirmation have dissented. The cases are briefly summarized.

CASE 1. (Fig. 1—Path. 6123.) In February, 1916, this patient, Mrs. E.B., then 25 years old, underwent a reconstructive operation for lacerations and prolapse. She had had 2 children, the last in 1911. A right sided trachelorrhaphy was performed along with vaginal plastic operations and suspension. In March, 1920, 4 years and 1 month later, she was seen because of 8 months' flowing and found to have advanced carcinoma of the cervix. Biopsy showed squamous carcinoma. Radium was applied. Death occurred 2 months later. The illustration is taken from the section of the trachelorrhaphy specimen which was diagnosed chronic cervicitis. A rediagnosis of early cancer was made. This case has already been reported (3).

CASE 2. (Fig. 2—Path. 9951.) At the time of operation (dilatation and curettage, trachelorrhaphy, anterior colporrhaphy, perineorrhaphy and supravaginal hysterectomy for chronic pelvic inflammation) in December, 1921, this patient, Mrs. M.R., was 38 years old and had had a normal pregnancy 17 years previously. Four years and 9 months later radium was applied to an advanced squamous cancer of the cervix. She was alive with a recurrence 1 year and 3 months after irradiation. The photomicrograph was made from the section of trachelorrhaphy tissue. The diagnosis of chronic cervicitis

was changed to early cancer. This case is being reported by Dr. R. L. Pearse in a series of supravaginal hysterectomies (2).

CASE 3. (Figs. 3 and 4—Path. 13885.) Mrs. S.S., aged 51 years. The last of 4 pregnancies occurred 14 years before admission. She was seen in May, 1926, because of profuse leucorrhœa without bleeding, of 9 months' duration. Examination and curettage under anæsthesia resulted in a diagnosis of senile vaginitis. The patient returned in 2 months, unrelieved. On this occasion a specimen was taken from the cervix and radium given. The patient is well, over 7 years later. The pictures were made of the biopsy section. This case would have been considered too advanced for inclusion in this series were it not that two well known Boston pathologists did not appraise the lesion malignant.

Case 4. (Figs. 5, 6, 7, and 8—Path. 14721.) Mrs. B.O., aged 27 years. The last of 6 pregnancies had resulted in abortion 1 year before admission. Complaint: flowing, of 14 days' duration. On April 5, 1927, dilatation, curettage, biopsy of the cervix, and trachelorrhaphy were performed. Two weeks later radium was applied. The patient was well over 6 years afterward. The illustrations were taken from sections of the trachelorrhaphy specimen. A general pathologist diagnosed the lesion chronic cervicitis.

CASE 5. (Figs. 9, 10, and 11—Path. 15196.) Mrs. M.D., 41 years old. She had had 5 pregnancies, the last ending with an instrumental delivery 4 years before. On September 26, 1927, she was admitted because of dysmenorrhœa and pressure in the vagina. Operation: dilatation and curettage, excision of periurethral cyst, trachelorrhaphy for deep tear into right parametrium, perineorrhaphy. A month later she was treated with radium and was well after 6 years. The photomicrographs were made from the trachelorrhaphy specimen which was diagnosed carcinoma *in situ*. This case has already been reported (3).

CASE 6. (Figs. 12 and 13—Path. 15457.) Mrs. J.M., aged 37 years. Pregnancies: 2, the last, ending with a premature labor at 7 months, 4 years before admission. Complaints: profuse leucorrhœa, 5 years; lower abdominal soreness and backache, worse with menstruation, 6 months; bloody discharge, 2 months. Operation, April 12, 1927: dilatation and curettage, biopsy and cauterization of the cervix, supravaginal hysterectomy for chronic pelvic inflammation, appendectomy. Pathological report: proliferating endometrium, fibromyoma, follicular salpingitis, chronic ovaritis, chronic appendicitis, chronic cervicitis. Because of recurrent staining, the patient was examined under an anæsthetic on January 3, 1928. There was no cervical erosion and the os appeared normal. Three soft, red, bleeding ulcers without raised edges, all less than 1 centimeter in diameter and all less than 1 centimeter from the external os, were excised and showed the characteristics depicted in the photomicrographs. The patient was well when examined 5 years and 10 months after treatment with radium. Careful re-examination of the specimens removed at the first operation failed to reveal any evidence of beginning tumor, although it would seem that there must have been incipient cancer at that time which was missed by the biopsy. This case has been reported (3).

Fig. 1.

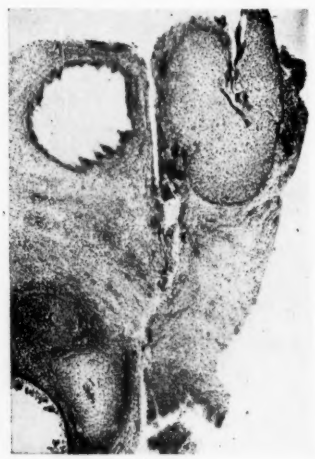

Fig. 2.

Fig. 1. Case 1. Poorly defined basal layer; fairly numerous mitoses; heavy infiltration by round cells.

Fig. 2. Case 2. Distinct basal layer, but cells are atypical and differentiate poorly. Mitoses are not numerous. Dense inflammatory reaction.

Fig. 3.

Fig. 4.

Fig. 7.

Fig. 5.

Fig. 6.

Fig. 8.

Fig. 3. Case 3. No basal layer. Much infiltration by round cells.

Fig. 4. Case 3. High power from Figure 3. Frequent mitoses. The cells are practically all of the spinal type.

Fig. 5. Case 4. Poor basal layer. The cells vary in size, shape, and density of staining, but tend to differentiate. Moderate inflammation.

Fig. 6. Case 4. High power photomicrograph made from same section as shown in Figure 5. Active, atypical cells.

Fig. 7. Case 4. More advanced stage of Figures 5 and 6.

Fig. 8. Case 4. Beginning invasion.

CASE 7. (Fig. 14—Path. 16194.) Mrs. A.C., aged 30 years. One full-term delivery 9½ years before admission. Catamenia every 2 weeks; no flowing between periods. Operation, February 20, 1929, consisted in dilatation and curettage, biopsy and cauterization of the cervix, supravaginal hysterectomy for chronic pelvic inflammation. Seven months after treatment with radium, examination revealed induration in both broad ligaments. The patient was alive with advanced recurrence 3 years after treatment. The illustration shows practically all the tumor found in the biopsy section. It is not unlikely, from the outcome in this case, that the tumor was more advanced at the time of first admission than the findings indicated. Nevertheless, a pathologist stated that the lesion was "probably not malignant."

CASE 8. (Figs. 15, 16, 17, and 18—Path. 18194.) Mrs. E.R., aged 29 years. One normal pregnancy 7 years before admission. Operation, September 24, 1930: dilatation and curettage, bilateral trachelorrhaphy, conservative operation for mild chronic pelvic inflammation. The photomicrographs were taken from the cervical specimens. Three years after irradiation the patient was well.

CASE 9. (Figs. 19 and 20—Path. 19178.) Mrs. G.C., aged 37 years. Pregnancies: 2 full-term deliveries, the last 15 years before admission; 2 abortions. Operation, July 4, 1931, consisted in trachelorrhaphy, anterior colporrhaphy, perineor-

Fig. 9.

Fig. 10.

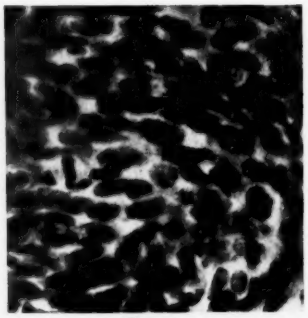

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

Fig. 9. Practically normal squamous epithelium on the left side. Carcinoma *in situ* on the right. Note distribution of round cells.

Fig. 10. Case 5. Higher power of Figure 9.

Fig. 11. Case 5. High power of Figure 10.

Fig. 12. Hypertrophied squamous epithelium on the left. Mass of atypical cells on the right with dense chronic inflammation around it.

Fig. 13. Case 6. Superficial atypical epithelium made up of anaplastic cells.

Fig. 14. Case 7. Basal layer absent. Poor differentiation.

rhaphy, supravaginal hysterectomy for chronic pelvic inflammation. The trachelorrhaphy findings are illustrated. Patient well 2 years 4 months after radium treatment. Pathologist's note: "precancerous."

CASE 10. (Figs. 21 and 22—Path. 19909.) Mrs. L.G., aged 32 years. Had had 10 full term deliveries. She was admitted to the hospital on January 20, 1932, because of intermittent flowing of 2 months' duration. Because of severe pulmonary tuberculosis only cervical biopsy was performed and radium applied. The illustrations were taken from the biopsy sections. The patient was alive with no evidence of cervical disease 1 year 4 months after treatment. Pathologist's note: "chronic cervicitis—atypical epithelium."

CASE 11. (Figs. 23 and 24—Path. 20326.) Mrs. A.M., aged 53 years. Pregnancies: 1 full term 23 years previous to admission. Menopause had occurred at the age of 48. Operation, January 23, 1932: dilatation, curettage and biopsy because of bleeding of 1 day's duration. The cervix appeared atrophied except for a small area of erosion on the posterior lip. One year and 6 months after treatment with radium the patient was well.

CASE 12. (Figs. 25 and 26—Path. 20067.) Mrs. A.Q., aged 51 years. Pregnancies: 8 full-term, 1 abortion. Complaints were those of prolapse; no abnormal flow or discharge. Operation, July 23, 1932, consisted in dilatation and curettage, bilateral trachelorrhaphy, anterior colporrhaphy, perineor-

Fig. 15.

Fig. 16.

Fig. 17.

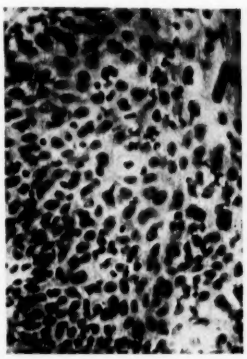

Fig. 18.

Fig. 19.

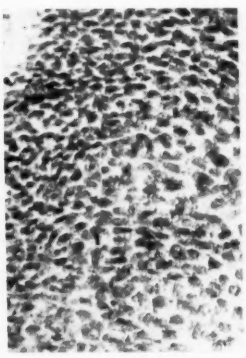

Fig. 20.

Fig. 15. Case 8. This may be an atypical hyperkeratosis, but the poor basal layer, the variability of the cells, and the chronic inflammation point more toward early malignancy, especially after considering the following illustrations.

Fig. 16. Case 8. Higher power from Figure 15.

Fig. 17. Case 8. Another area from the same sections as Figures 15 and 16. At first glance this does not appear to be anything more than a simple erosion. Under higher power (Fig. 18), however, there is apparent excessive and abnormal activity.

Fig. 18. Case 8. High power from Figure 17. Frequent mitoses, pleomorphism, hyperchromatism.

Fig. 19. Case 9. On the left the epithelium differentiates fairly well, although the basal layer is not clean cut. The epithelium on the right shows all the characteristics of carcinoma except invasion.

Fig. 20. Case 9. High power from Figure 19.

Fig. 21. Case 10. No basal layer, almost no differentiation. Possibly beginning invasion.

Fig. 22. Case 10. High power from Figure 21.

Fig. 21.

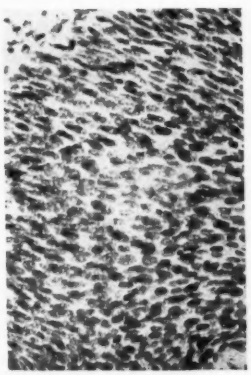

Fig. 22.

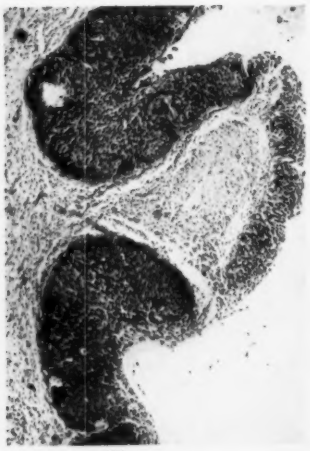

Fig. 23.

Fig. 25.

Fig. 27.

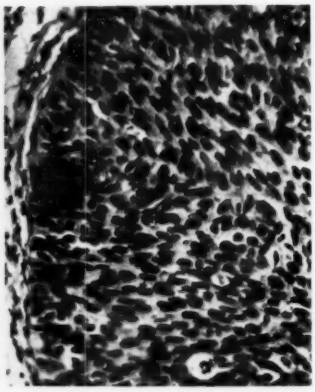

Fig. 24.

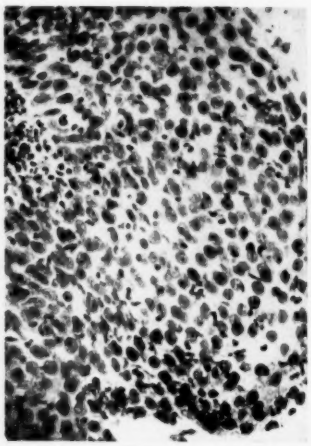

Fig. 26.

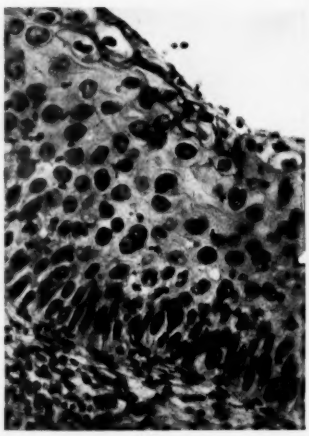

Fig. 28.

Fig. 23 Case 11.

Fig. 24. Case 11. High power from Figure 23.

Fig. 25. Case 12. The extremely dense infiltration with round cells and the atypical activity shown under high power (Fig. 26) make this seem to be more than a healing erosion.

Fig. 26. Case 12. High power from Figure 25.

Fig. 27. Case 13. Some differentiation; pseudo-basal layer, marked chronic inflammation, numerous mitoses.

Fig. 28. Case 13. High power from Figure 27. In normal or hypertrophied epithelium and in the epithelium of erosions rarely is it possible to find more than 2 mitoses in a high power field.

rhaphy. The trachelorrhaphy section is illustrated in the photomicrographs. One year and 3 months after irradiation the patient was well and examination revealed no abnormality.

CASE 13. (Figs. 27 and 28—Path. 21167.) Mrs. M.S., aged 38 years. Pregnancies: a normal labor 14 years before admission and an induced abortion 10 years before. The patient was first seen in October, 1932, because of lower abdominal pain, backache, bearing down and vaginal discharge, all of 2 years' duration. There had been no abnormal flowing. Operation was advised but not urged. Operation, December 29, 1932: dilatation and curettage, biopsy and cauterization of cervix, anterior colporrhaphy, supravaginal hysterectomy for chronic pelvic inflammation. The findings in the biopsy are illustrated in the photomicrographs. The patient was well 11 months after irradiation. Three pathologists did not consider the biopsy sections malignant.

CASE 14. (Figs. 29 and 30—Path. 21400.) Mrs. E.M., 49 years old. The last of her 3 pregnancies

Fig. 29.

Fig. 31.

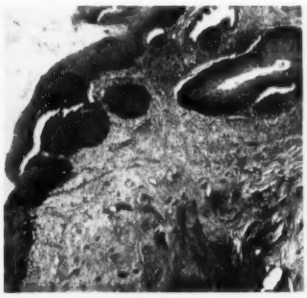

Fig. 33.

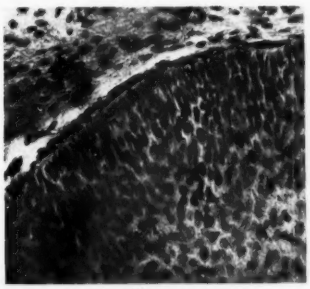

Fig. 34.

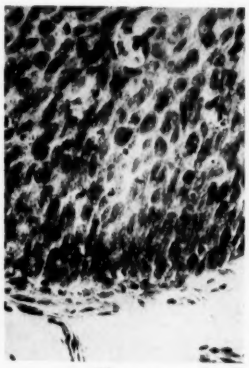

Fig. 30.

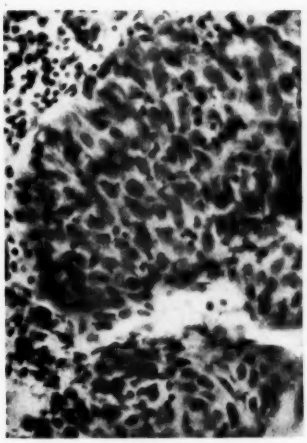

Fig. 32.

Fig. 29. Case 14. No basal layer, numerous mitoses, atypical cells with poor differentiation.

Fig. 30. Case 14. High power from Figure 29.

Fig. 31. Case 15. No basal layer, marked inflammation and atypical cells, but only few mitoses.

Fig. 32. High power from Figure 31.

Fig. 33. Case 16. There is a short stretch of normal epithelium in the lower left corner. Chronic inflammation and early invasion are apparent.

Fig. 34. Case 16. There is no basal layer. The cells differentiate poorly. Mitoses are present.

had gone to term 20 years before admission. Between December, 1931, and March 6, 1933, the date of operation, she had been seen often because of slight menstrual irregularities and a small fibroid uterus. There was some cervical erosion which healed well after mild cauterizing. Menorrhagia and lower abdominal pain made it advisable to operate. Complete hysterectomy was performed. The routine section of the cervix happened to show the lesion depicted in the photomicrographs. Pathologist's note: "no invasion—active epithelium."

CASE 15. (Figs. 31 and 32—Path. 8423.) Mrs. H.C., aged 34 years. Pregnancies: 3, the last, 15 years ago. Operation, May 20, 1919: dilatation and curettage, trachelorrhaphy, supravaginal hysterectomy for chronic pelvic inflammation. The section from the cervix was diagnosed chronic cervicitis. In December, 1931, 12 years and 6 months after the above operation, the patient appeared at another Boston hospital because of a bloody vaginal discharge of 3 weeks' duration. Biopsy showed epidermoid carcinoma, grade II. Six months after irradiation she was apparently well, with no evidence of recurrence. The accompanying photomicrographs were made from the original trachelorrhaphy section, which has recently been re-examined and submitted to others for opinion. All agree that it is "most suspicious" of early malignancy, despite the fact that cancer was not evident clinically until over 12 years had passed. Since it seems impossible for cancer to be present so long before giving symptoms, it is conceivable that trachelorrhaphy removed the lesion and that another cancer developed subse-

quently. On the other hand, it could be argued that this lesion was not malignant. We have committed ourselves to a diagnosis of very early cancer in this instance after considerable hesitation. This case is being reported by Dr. R. L. Pearse in a series of supravaginal hysterectomies (3).

CASE 16. (Figs. 33 and 34—Path. 14565.) Mrs. E.S., 28 years old. She had had 5 children, the last 2 years before admission. At operation, February 16, 1927—dilatation and curettage, cauterization of the cervix, bilateral trachelorrhaphy, anterior colporrhaphy, perineorrhaphy, lysis of peritoneal adhesions, right salpingo-oophorectomy, appendectomy, suspension—tuberculous salpingitis was found. Convalescence was complicated by a sinus in the abdominal wound which did not heal until 9 months after operation. The illustrations are taken from a section of the cervical specimens. We considered the lesion malignant, but, because of the patient's condition and out of deference to the opinion of a consulting pathologist who unequivocally diagnosed the condition chronic endocervicitis, the patient's cervix received no further treatment. She then failed to respond to follow-up letters and was lost. It has recently been discovered that she underwent complete hysterectomy on April 1, 1933, for cancer of the cervix, 6 years and 1 month after trachelorrhaphy, and died of the disease in September, 1933. The clinical diagnosis was confirmed by pathological examination.

In 5 of the 16 cases cited malignancy was suspected before operation—in 4 instances because of abnormal flowing and once because of leucorrhœa after the menopause. The gross appearance of the cervices, with but one exception (Case 6), did not suggest the possibility of cancer any more than the average parous cervix. In reviewing the records of the cases cited it is interesting to note that 9 were found to have chronic pelvic inflammation. Another had tuberculous pelvic inflammation. Three other interesting points are observed. First, the large number of pregnancies that 3 of the younger patients had (6 before the age of 27, 5 before the age of 27, and 10 before the age of 32); second, the long intervals between pregnancy and the finding of the above lesions (over 5 years in 11 cases; over 10 years in 8 cases); and, third, the long intervals between the finding of early lesions and the appearance of cancer clinically (Cases 1, 2, 16, and (?) 15).

## SUMMARY

Sixteen cases that have been outlined and illustrated show, in our opinion, very early malignant lesions of the cervix. They are presented not only in corroboration of Schiller's work but also because they are such as may fail to be considered seriously by those not constantly studying gynecological pathology.

We are grateful to Dr. W. W. Boyd, Dr. S. C. Graves, and Mr. Richard W. St. Clair for their photomicrographs.

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# CLINICAL MANIFESTATIONS OF THE CHROMAFFIN CELL TUMORS ARISING FROM THE SUPRARENAL MEDULLA

## Suprarenal Sympathetic Syndrome

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IN the consideration of the syndromes produced by certain lesions of the suprarenal glands, little or no attention has been given to the clinical states associated with the chromaffin cell tumors. The literature regarding these tumors is mostly foreign and the contributions have been chiefly from the pathological point of view. These neoplasms have been generally viewed as being extremely rare and of little clinical significance. It is the purpose of this paper to present: first, a complex group of signs and symptoms associated clinically with the pheochrome tumors of the suprarenal medulla; second, the report of a case illustrating the syndrome; third, a detailed analysis of the reported cases together with the facts of clinical importance related to them.

### THE SYNDROME

The stimulus for this study of the clinical syndrome associated with the pheochromocytomata of the suprarenal medulla was initiated by our failure to make a correct clinical diagnosis in a patient who presented an extraordinarily dramatic group of signs and symptoms which went uninterpreted until after the necropsy, when the diagnosis was established. Even after the necropsy, the pathological diagnosis was made with considerable study. It was for these reasons that we began an intensive review of the medical literature relating to these tumors. We found that, in a majority of the reported cases in which complete histories and physical examinations were given, the patients manifested signs and symptoms indicating an instability of the sympathetic nervous system, often including *paroxysmal sympatheticotonia*. Chief among these signs and symptoms were: *Hypertension* or *paroxysmal hypertension*, *glycosuria*, and *periodic attacks of tachycardia*, *vasoconstriction* and *vasodilatation of the peripheral vessels*, as shown by *pallor* followed by *flushing of the skin; headaches*, *nausea*, *vomiting*, nervous manifestations with *sensations* of constriction in the epigastrium, *dyspnœa*, *suffocation*, or choking. When subjected to surgical procedures these patients, with few exceptions, manifested an unusual *susceptibility to shock*. *Pulmonary œdema* and *hypertrophy of the heart* were the most frequent associated pathological findings. The deep seated site of the organ involved makes the clinical perception of the *tumor*, which acts as the causative lesion, a variable finding depending upon the size of the tumor and the thoroughness of the physical examination.

### CASE REPORT

A Jewish woman, aged 45 years, referred by Dr. Carl Conn, of Los Angeles, entered the Hollywood Hospital with the following complaints: For the last 2 years she had had frequent attacks of nausea, vomiting, dizziness, palpitation of the heart, profuse perspiration, pallor then flushing of the skin, followed by severe headaches. These attacks most often occurred when the patient first arose in the morning. They also occurred unexpectedly during the day. Two weeks previously Dr. Conn had discovered a mass in the right upper quadrant of the abdomen. The patient had never noted pain in the region of this mass.

Seven years previously she had been operated upon by Dr. Conn for a fibromyoma of the uterus which was removed. At that time the dismissal note indicated that when the patient left the hospital she was apprehensive about her heart because of a slight palpitation. The blood pressure was 140/78 millimeters mercury. There were no palpable masses in her abdomen.

Physical examination revealed the following: The general appearance was that of a normal woman of her stated age. There were visible pulsations of the large vessels of the neck. A blowing systolic murmur was present, heard best in the aortic area. The blood pressure was 170/80 millimeters mercury, and the pulse rate was 90. The temperature range throughout 48 hours' observation did not vary from normal. There was a rounded, smooth, slightly movable, firm mass in the right flank, palpable and

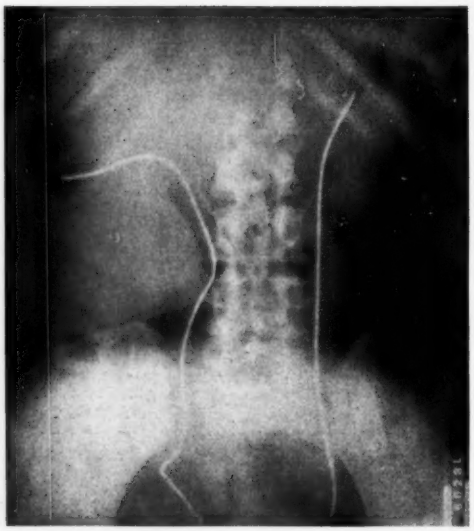


Fig. 1. Roentgenogram, with ureteral catheters in place, showing large tumor in the region of the right kidney.

visible also. This mass appeared to be about the size of a large grapefruit.

Cystoscopic examination was made and ureteral catheters passed without difficulty to both kidney pelves (Fig. 1). Urine specimens were obtained from each side. Pyelograms were made which showed the right kidney to be ptosed and rotated through 90 degrees with an enlarged pelvis (Fig. 2). There was an ovoid shadow at the outer border of the kidney parenchyma in the roentgen plate. Following the cystoscopic examination the patient revealed an unusual degree of weakness and perspired profusely.

Roentgenological examination of skull, chest, and bones showed no evidence of metastasis or other abnormalities. Urinalysis revealed glycosuria one plus, and a trace of albumin. Phenolsulphonephthalein elimination was 15 per cent right, and 20 per cent left, in 15 minutes after intravenous injection. Gram's stain of the urine from both kidney pelves revealed no abnormal cellular elements and cultures showed no growth. The blood count was: erythrocytes 5,550,000; white cells 10,200 with 74 per cent polymorphonuclears; hæmoglobin 87 per cent (Sahli).

A tentative diagnosis of hypernephroma was made and it was decided to make a surgical exploration of the right kidney region. Accordingly on the morning of October 23, 1931, the patient was given ¾ grain of ephedrine hypodermically and taken to the operating room where a spinal anæsthetic was given, using 150 milligrams of neocaine. The patient was placed on her left side in the overhand swimming position and the kidney "lift" was raised. She immediately became ashen in color and covered with sweat. She was intensely nauseated and vomited for several minutes. The blood pressure was taken at once and systolic readings above 300 millimeters mercury, the upper limit of the instrument's calibration, were recorded (Fig. 3). With the manometric reading at 300 millimeters mercury pulsations could still be loudly heard over the brachial artery below the cuff of the blood pressure instrument. The diastolic reading was 240 millimeters mercury. No incision was made and the patient was returned to her room. The pulse was then rapid and weak, her hands were cold and clammy, she was conscious, coughing, and expectorating brown mucus. The temperature was 101.6 degrees F., pulse 135, respiration 35.

Two hours later the blood pressure was 230/150 millimeters mercury, pulse rate 128, and a slight exophthalmos was noted. At 12 noon the blood pressure had fallen to 180/120 millimeters mercury. The pulse was 132 and the patient vomited brownish fluid flecked with bright blood. The body and face were very warm and intensely red. At 2:30 p.m. the chest was full of râles and a bilateral nystagmus was observed. The patient complained of dizziness. At 4:00 p.m. the electrocardiogram showed a sinus tachycardia with a pulse of 140. The blood pressure was 130/80 millimeters mercury. The blood pressure then gradually fell and was observed to be 120/90 millimeters mercury at 9:00 that evening. The urine output was only 350 cubic centimeters in this 12 hour period notwithstanding the administration of intravenous glucose. The following morning when the temperature was 104 degrees F. the arterial tension had become 200/95 millimeters mercury. The pulse rate was 120. During the following day the patient suffered from a severe attack of pulmonary œdema. Cyanosis gradually became more in evidence. Nausea and vomiting persisted. The blood pressure fluctuated but gradually fell. Late in the evening her condition grew much worse, the abdomen became distended, temperature 106.4 degrees F., pulse weak, respirations labored. She became comatose. Early the following morning the temperature had risen to 107 degrees F., the pulse was barely perceptible at the wrist, and the patient's lungs and mouth were filled with mucus. The patient expired at 7:20 a.m. Necropsy was performed at 9 a.m. by Dr. V. L. Andrews, pathologist of the Hollywood Hospital.

*Necropsy report.* The body was that of a well developed and well nourished white female whose apparent age was 45 years. The skin was white and soft. The distribution of hair was normal. The thyroid was congested but normal in size. The lungs were dark colored and crepitant. Cut section showed congestion, scattered hæmorrhages, and œdema. The heart musculature was firm, dark colored, and hyperthrophied. The blood vessels were everywhere soft and elastic. The liver was dark colored. Its cut section revealed minute scattered hæmorrhages. There was present a generalized

cloudy swelling which obscured the lobulations. Except for the absence of the uterus, the rest of the abdominal contents showed no deviation from normal. When the calvarium was opened the meninges were found to be dry. Section revealed no abnormality of the brain tissue. The pituitary body was normal. The right kidney was pushed forward, outward, and downward by a mass above and behind it. This kidney was smaller than normal. The pelvis held 25 cubic centimeters. The kidney tissue was compressed and showed cloudy swelling. The ureter was dilated to twice its normal diameter in its upper third. There was no inflammation in the kidney tissue or pelvis. The mass behind the right kidney replaced the right suprarenal gland.

*The tumor.* It was an elongated fused mass of lobules which separated readily into two lobes (Fig. 4). The upper lobe which occupied the position of the suprarenal gland measured 14.5 centimeters by 8 centimeters by 6 centimeters. The lower lobe passed down behind the kidney pushing it forward and down. It was very lobulated and measured 12 centimeters by 8 centimeters by 6 centimeters. Both lobes were quite cystic. A large amount of clotted and fluid blood was found in cystic cavities within the lower lobe. Section of the upper lobe showed some clotted blood in cystic cavities but here the tumor tissue was more solid and uniform. The growth itself had a beefy red color and was soft. One could not identify cortical tissue. The surface layers were a little firmer to palpation than were the deeper portions but they revealed no difference in color. The entire mass was definitely delimited, shelling out readily from its bed. The tumor did not invade any of the surrounding tissues. A single artery and its accompanying vein connected the kidney to the tumor mass. Three small arteries supplied the tumor from the renal artery and many others ran into it from the aorta and the neighboring vessels.

*Microscopic report.* Sections of the thyroid gland showed almost complete destructions of the thyroid tissue which had been replaced by fibrous and lymphoid tissue. The blood vessels of the thyroid were prominent, large and deeply congested. The left suprarenal was normal. There was no evidence of nephritis in either kidney.

Microscopic section of the tumor mass showed it to be made up of structures in gland formation in which the lining cells assumed a low cylindrical form (Fig. 5). Basement membranes were everywhere intact. In places the formation was in long strands giving the impression of cords of cells. There was no visible fibrous framework. The prevailing type of cell was considerably more differentiated than that ordinarily seen in the medulla. In the hematoxylin-eosin stained sections the cytoplasm of these large cells was pink and granular, the nucleus oval and light staining (Fig. 6). There was an absolute lack of mitotic figures. Throughout the tumor mass were large blood spaces and cysts.

Fig. 2. Pyelogram showing dilatation of the pelvis of the right kidney. Note ptosis of kidney and tumor shadow.

*Chemical examination.* A portion of the tumor was removed immediately and a quantitative chemical determination for epinephrine according to the method of Folin, Denis, and Cannon, yielded 2 grams of this drug to 100 grams of tissue. Numerous color reactions were used as qualitative tests of this extract and were all confirmatory for epinephrine.[1]

*Pathological histological diagnosis.* Pheochromocytoma. This diagnosis was confirmed by Dr. C. F. Geschickter of Baltimore and Dr. W. J. Merle Scott of Rochester, New York.

## SUMMARY OF CASE

The patient was a middle aged woman with a large retroperitoneal tumor thought to be an hypernephroma. Her clinical story was misinterpreted as being neurotic or climacteric manifestations. It is now revealed to have been a very characteristic and significant history of paroxysmal sympatheticotonia. A surgical exploration was planned. A spinal anæsthetic was given but no surgical incision was made. From the time the patient entered

[1]The chemical determinations were carried out by Miss Hull, hospital biochemist, working under the direction of Dr. V. L. Andrews, of the Hollywood Hospital.

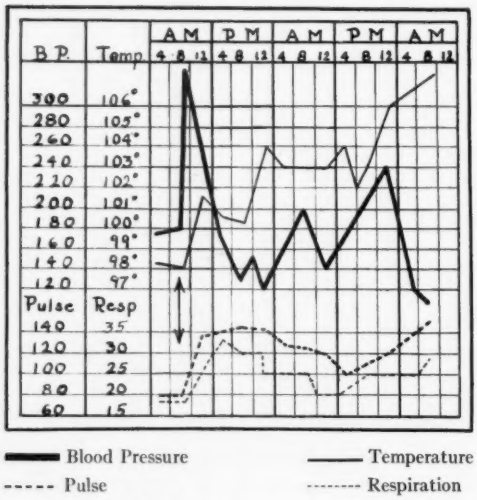



Fig. 3. Chart showing fluctuations of blood pressure, temperature, pulse, and respiration. Arrow indicates the time of the patient's entrance to surgery.

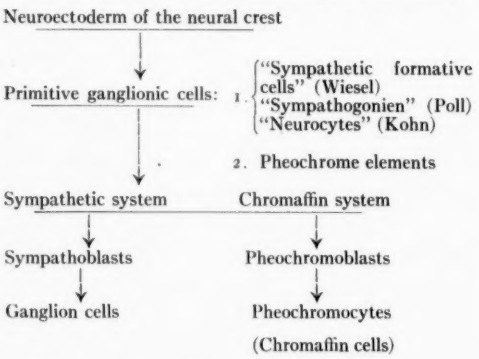
the operating room until her death the extraordinary succession of events which took place could not be explained upon the basis of any syndrome known to us.

At necropsy a large cystic chromaffin cell tumor, weighing 1000 grams, was found replacing the right suprarenal gland (Fig. 7). Subsequent quantitative chemical analysis of a portion of the tumor proved it to contain the enormous quantity of over 2 grams of adrenalin per 100 grams of tissue.

## DEVELOPMENTAL ANATOMY

The nature of these neoplasms may be better understood by briefly considering the embryological development of the suprarenal glands. These glands are developed from two sources. Their cortical portion is derived from the mesoderm. The medulla is ectodermal in origin since it is derived from ganglions of the sympathetic system.

The developing ganglions become differentiated either into the sympathoblasts of the sympathetic system or into the pheochromoblasts of the chromaffin system. Sympathoblasts develop into ganglion cells. Pheochromoblasts are destined to give rise to the pheochromocytes, known also as chromaffin cells. This may be expressed diagrammatically:




The primitive pheochrome elements become separated from the ganglions and migrate to the region of the cortex, subsequently aggregating in its center. In this migration sympathoblasts also are carried along with these pheochrome cells and give rise to the ganglion cells within the gland. Similarly, it is an interesting fact that some of the pheochrome cells become diverted from their course and instead of entering into the formation of the suprarenal medulla they become permanently associated with some of the prevertebral and peripheral sympathetic ganglions as small masses of accessory medullary tissue. To these Kohn gave the term paraganglions.

The pheochromoblasts in the suprarenal medulla, as well as those within the paraganglions, probably do not become finally differentiated into the mature pheochromocytes until after birth. At this time these cells, which are now mature, undergo a chemical change which makes them assume a brown color when treated with chrome salts, such as potassium bichromate. Hence these cells are called chromaffin or pheochrome cells. No other tissue in the entire scale of animal life gives this reaction. It is these specific cells which produce adrenalin. The chromaffin system consists of these cells located in the medulla and in the paraganglionic tissue. That tumors may arise from these cells is now well established. Formerly these tumors were described by various names, viz., sarcoma, angiosarcoma, perithelioma, carcinoma, et

cetera, until Alezais and Peyron in 1908, described a chromaffin cell tumor originating from a paraganglioma in the sacrococcygeal region and gave the name paraganglioma to all such tumors wherever they are found. Pick, however, in 1912, called attention to the fact that these tumors should be named after the predominating type of cell, namely the pheochromocyte. He suggested that these tumors arising from the suprarenal medulla itself should be called pheochromocytomata and that the term paraganglioma should be reserved for those arising outside the main gland, that is, from the paraganglions.

### CLINICAL ANALYSIS OF REPORTED CASES

We have reviewed the reports of 60 cases which have been considered by various authors to have been chromaffin cell tumors arising from the suprarenal medulla. One case, however, of extra suprarenal pheochrome tumor (paraganglioma) is included in this review due to its location in the adjacent area, the size of the tumor, and the significant clinical report. There were 8 cases which were either malignant, as shown by metastases, or were associated with definite malignancy in other organs (Table II). In the majority of these cases which showed malignant neoplastic growth, no clinical information was given but merely the pathological report of the necropsy findings. Five of the early reported cases (Frankel, Perley, Berdez, Robert, Manasse—1893), which have been considered by certain authors to have been pheochrome tumors do not, in our opinion, contain sufficient evidence definitely to establish their identity. There were 6 cases mentioned in the literature on which no data were presented. Nineteen of the remaining cases did not have clinical histories and physical examinations in their reports (Table I). There were only 23 cases of benign chromaffin cell tumors of the suprarenal medulla with clinical histories and examinations reported in the literature. Several of these case reports are extremely brief and may be conveniently presented in tabular form (Table III). The majority of this group showed definite evidences of instability of the sympathetic nervous system. A few, however, with detailed reports, were overshadowed by complications and no conclusions regarding the clinical manifestations could be drawn.

Fig. 4. Photograph of pheochromocytoma replacing the right suprarenal gland.

We have summarized some of the most typical cases in detail due to their importance in evaluating the clinical manifestations associated with the pheochromocytomata.

Labbe, Tinel, and Doumer, 1922, deserve the credit for reporting a classic case in which the complete clinical and pathological observations were recorded in detail, thereby contributing the first case which may be used as a basis for a study of the typical clinical states manifested by the chromaffin cell tumors.

CASE 1. Mme. L., aged 28 years, complained of attacks of nausea and vomiting followed by characteristic nervous manifestations, which had recurred at irregular intervals for several months. These attacks had gradually become more excessive, recurring three or four times a week, often when the patient first awoke, or soon after breakfast, but also at other times during the day. There was no pain

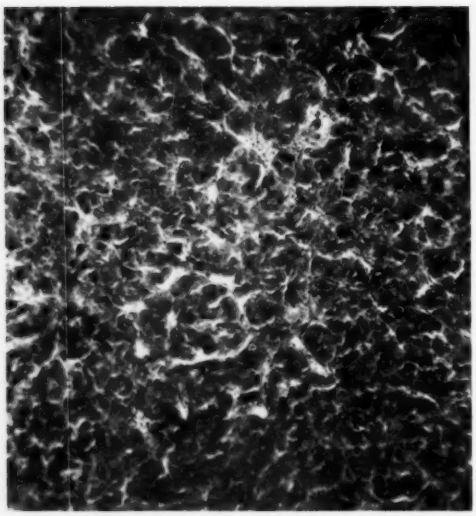


Fig. 5. Low power photomicrograph of tumor.

with the attacks. The attack began as a general malaise, coldness, tingling of the extremities, face becoming pale, appearance of vasoconstriction of hands and feet, and a feeling of a constriction in the epigastrium with nausea followed by vomiting. The heart rate became accelerated into a severe tachycardia which was followed by vasodilatation of the face, neck, and chest with profuse perspiration. The extremities were cool and the patient was cyanosed. During the attack the urine was suppressed but the secretion reoccurred a few hours later. Physical examination revealed a paroxysmal hypertension which varied from day to day and from hour to hour. The systolic pressure would range from 280, 270, 260 millimeters mercury down to 160, 140, 130, 125 millimeters mercury. Two readings outside of the attacks were 150 and 100 millimeters mercury. The patient soon developed a persistent glycosuria: The oculocardiac reflex was accentuated. She was dismissed from the hospital with a diagnosis of either non-goitrous hyperthyroidism or a neurocirculatory manifestation. However, she returned 2 months later with an acute attack of pulmonary œdema. The patient stated that during the interval the attacks had increased in severity and in frequency, occurring nearly every day. Intermittent fever now persisted from 39.5 degrees C. to 40 degrees C., rarely as low as 37 degrees C. During her stay in the hospital she had three attacks of pulmonary œdema. She died in a severe paroxysmal attack with acute pulmonary œdema.

*Necropsy:* The heart weighed 340 grams. It was apparently normal. The lungs were filled with fluid and the liver showed small islets of hæmorrhages. The kidneys appeared normal, and on section no trace of sclerosis or glomerular lesions could be found. Thyroid and ovaries appeared normal in the gross, but microscopic study of the thyroid gland showed considerable evidence of hypersecretion—increase in volume of colloid material, and increase in number of vesicles. The left suprarenal was replaced by a tumor the size of a small orange. Histological diagnosis was "paraganglioma" of the suprarenal medulla.

Mayo, 1927, reported an extra suprarenal pheochrome tumor (paraganglioma) which was successfully removed at operation.

CASE 2. A woman, aged 30 years, suffered intermittently from peculiar acute attacks, characterized by the sudden onset of discomfort in the precordium, headache, generalized pallor, cold and clammy skin, and a peculiar choking sensation followed by nausea and vomiting. Cough frequently occurred during the attack with expectoration of frothy saliva frequently tinged with blood and associated with signs of pulmonary œdema. Observation and study showed that these attacks were in the nature of intermittent paroxysmal hypertension (the systolic blood pressure often exceeded 300 millimeters mercury and 180 millimeters mercury diastolic), that they were attended by generalized vasoconstriction or a spasm, as evidenced by pallor of the skin and complete obliteration of capillaries of the nail folds during attacks. Exploratory operation revealed "An oval mass (about 6 by 4 centimeters), situated retroperitoneally, behind the tail of the pancreas, on the mesial side of the left kidney, and impinging against its upper pole." The tumor was successfully removed. In a recent communication the patient is reported to have been free from symptoms to date. The pathological diagnosis at that time was "malignant blastoma" but subsequent studies by Dr. Macarty, and others, have caused this tumor to be regarded as a pheochrome tumor arising from the chromaffin system (paraganglioma). Through the kindness of Dr. Mayo we had the opportunity of studying sections of this tumor in collaboration with Drs. V. L. Andrews and Brem, Zeiler, and Hammack, pathologists.

This highly interesting case of Dr. C. H. Mayo is again a typical case of the "suprarenal sympathetic syndrome." In this case the author made the unique clinical observation that the patient's entire clinical syndrome was in some way mediated through the sympathetic nervous system and that the causative lesion was probably a tumor intimately connected with this system.

Rabin, in 1929, reported a typical case of this syndrome and added a critical review of the histological constitution and associated clinical conditions in 30 of the reported cases. This author stated that, "Outstanding in this

review is the large percentage of cases associated with hypertension and signs of vasomotor or autonomic instability. The occurrence of hypertension at an early age, the inability of so many of these patients to withstand minor operative procedures and the sudden death without demonstrable cause in this case appear also to be more than simple coincidences."

CASE 3. A Polish woman, aged 45 years, had been suffering for many years from nervous manifestations similar to exophthalmic goiter. These symptoms were: hypertension, palpitation, tremor, dyspnœa on exertion, cough, nausea, vomiting, and fever. Physical examination revealed a blood pressure which fluctuated from 226 systolic, 180 diastolic to 177 systolic and 122 diastolic millimeters mercury. Finally meningeal signs developed and the patient died in coma. Necropsy revealed an advanced hypertrophy of the heart, generalized arteriosclerosis, and a pheochromocytoma of the medulla of the right suprarenal gland. A delayed quantitative chemical analysis of this tumor proved it to contain 1.5 milligrams of epinephrine per gram of tissue. The thyroid, brain, and meninges were normal. The right kidney on section showed no abnormality. The left revealed a few sharply defined hæmorrhagic areas within the cortex.

Vaquez, Donzelot and Geraudel, 1929, described a typical case of the "suprarenal sympathetic syndrome" in which deep radiation was unsuccessful. Though at first the patient's symptoms greatly subsided, they returned later more severe than ever. Another fact of equal importance is that the attacks of hypertension which were at first intermittent and paroxysmal finally developed into a permanent hypertension.

CASE 4. A man, aged 37 years, had been suffering from acute painful "crises," paroxysmal in character. Just as a complete physical examination had been finished the patient suddenly declared, "now my attack is beginning." The whole body became suddenly pale and the face had a mournful appearance. The pulse rate increased rapidly from 70 to 100 in a minute and the aortic second sound, previously normal, became greatly accentuated. The sphygmomanometer had not been removed from the arm; the pressure was taken at once. It had passed from 140/80 to 300/80 millimeters mercury. The height of the attack was reached in about 3 minutes when it began to decrease. During a similar previous attack the patient had suffered a hæmorrhage into the retina of the right eye, which caused a gross diminution in visual acuteness. He developed an acute attack of pulmonary œdema with

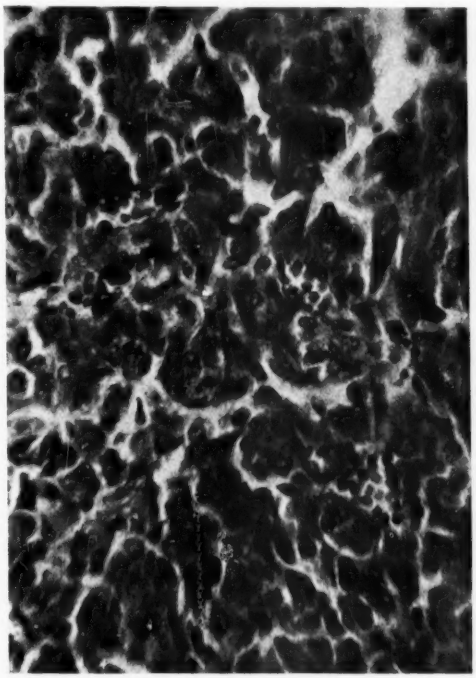


Fig. 6. High power photomicrograph of pheochromocytoma showing details of the cellular structure.

frothy sputum tinged with blood. These attacks recurred almost daily. Following a particularly violent attack, the patient often had an intense sialorrhea with epiphora, and also an albuminuria. "The complete physical examination which was made several times outside of the attacks did not reveal the existence of any objective symptoms worthy of note." As the patient refused surgical exploration he was referred for radiological treatment. The result of irradiation in the lumbar region was at first very gratifying but unfortunately the patient's attacks recurred after several months with even greater severity. The hypertension which was at first paroxysmal had at this time become permanent (210/130 millimeters mercury). These attacks sometimes included painful abdominal colic similar to lead poisoning, at other times the discomfort was confined to the thoracic region, while often violent headache predominated. Finally the patient became completely bewildered, agitated, and blind. He could not sleep, had no appetite and had continual nausea and vomiting. Soon the patient became comatose and died. Necropsy revealed hypertrophy of the left ventricle of the heart and a cystic chromaffin cell tumor (7 by 6 by 5 centimeters) which was situated in the right suprarenal gland.

Fig. 7. Sagittal section of tumor showing cystic and necrotic areas.

Shipley, 1929, reported another typical case of the "suprarenal sympathetic syndrome" in which two operations were necessary to find and remove the tumor. Notwithstanding the fact that the patient suffered from severe shock and developed alarming respiratory symptoms, she survived the operations and was cured of her attacks.

CASE 5. The patient was a young woman, aged 26 years, who, for the past 10 years, had suffered with periodic vasomotor attacks characterized by a hot flushed feeling in both arms followed by a sensation of tightness and compression over the heart, which would beat forcibly. There was a feeling of difficulty in breathing and a swelling in the neck. This was followed by nausea and often vomiting. These attacks increased in violence and in frequency, and severe occipital headache was an increasingly troublesome symptom. Between attacks the patient was apparently perfectly normal with a blood pressure reading of 120 millimeters mercury systolic and 90 millimeters mercury diastolic.

Examination during the attack revealed a steadily increasing hypertension which at one time went as high as 260 millimeters mercury systolic and beyond the point where the instrument would register. "During the height of the attack there was marked pulsation of the vessels of the neck, the jugulars were prominent, the head, feet, knees, and nose were quite cool to the touch; the face a little flushed, there was marked tremor of the hands, the respirations were shallow and increased to 36, and pulse rose gradually to 110 and fell to 76 with the fall of blood pressure."

The left suprarenal gland was explored and found normal but a tumor was palpated in the right suprarenal region. Due to the inability to remove this tumor through the initial incision it was decided to close the wound and to reopen the abdomen at a later date.

Thirteen days later the abdomen was reopened and a tumor was found replacing the right suprarenal gland. The tumor was removed, the wound closed, and the patient was returned to her room "quite shocked." The blood pressure was very low for several hours. She developed a well marked grayish cyanosis, and the respirations were rapid and shallow. At the most critical period she spat up a small quantity of frothy sputum containing some bright red blood. Finally these symptoms subsided but her blood pressure remained low, ranging between 95 systolic, 65 diastolic, and 110 systolic and 70 diastolic millimeters mercury. The patient reported herself, 10 months later, as entirely well and free from attacks. The pathological diagnosis of the tumor was "paraganglioma of the suprarenal medulla." It was found to contain an excessive amount of epinephrine.

Labbe, Violle, and Azerad, 1930, described their excellent observations on a clinical case of "paroxysmal sympatheticotonia" which had been followed for 12 years. Finally, at the age of 29, the patient died from cerebral hæmorrhage.

CASE 6. This patient had been evacuated from the battle front in 1918 with an illness thought to be chronic nephritis. But from this time on the variations of his arterial tensions held the attention of his physicians, and caused a great deal of discussion. His blood pressure ordinarily around 160/100 millimeters mercury was subject at times to paroxysmal attacks during which the systolic pressure increased to 250, 300 millimeters mercury or even higher. These attacks began with a feeling of apprehension, pallor, haggard eyes, and dilated pupils. Then followed violent palpitations, with an increase of the usual tachycardia, considerable cardiac irritation, and increased arterial tension. These attacks usually lasted for an hour and ended with sweating. They were repeated at close intervals, sometimes occurring twice in one day. The patient's urine contained some albumin, 0.06 to 0.12 centimeter per liter, and his azotæmia was slightly increased, 4.5 centimeters per 1000 cubic centimeters. Finally evidences of a cerebral hæmorrhage became manifest and the patient died in coma.

*Necropsy:* There was a chromaffin cell tumor of the right suprarenal body the size of a small orange.

TABLE I.—CASES WITHOUT HISTORY AND PHYSICAL EXAMINATION

| Author Date | Age Sex | Tumor location and size | Clinical diagnosis | Pathological diagnosis | Remarks |
|---|---|---|---|---|---|
| Manasse 1896 | 70 M | Left Hen egg | None | Hyperplastic med. tumor | First case in which the chromaffin reaction was demonstrated |
| Marchetti 1904 | 15 M | Bilateral Pea | Typhoid fever | Hyperplasia sup. med. | The first case with bilateral occurrence |
| Suzucki 1909 | 62 M | Left 10 cm. | Fractured femur<br>Bronchial asthma<br>Thrombophlebitis<br>Myocarditis<br>Pulmonary œdema | Chromaffin cell tumor<br>Thrombosis of femoral and iliac veins (left)<br>Abscess of kidney<br>Lobar pneumonia | The solution in which the tumor was placed turned green and gave adrenalin chemical reactions |
| Suzucki 1910 | 60 F | Right ½ cm. | Neurofibromatosis<br>Tuberculosis right wrist<br>Inguinal hernia<br>Kyphosis of spine | Chromaffin cell tumor<br>Chronic tuberculosis of lungs, left suprarenal, intestines, peritoneum, right hand and spine | The clinical manifestation of such a small nodule would have undoubtedly been overshadowed by the coexisting complications |
| Suzucki 1910 | 82 F | Right 1 cm. | Emphysema of lungs<br>Chronic bronchitis<br>Pneumonia | Paraganglioma and lipoma<br>Pneumonia<br>Arteriosclerosis | The author believed this nodule was composed of fat cells plus chromaffin cells. Only a few cells showed chromaffin reaction |
| Hedinger 1911 | 34 F | Left 10 cm. | Criminal abortion (fourth month)<br>Anæmia | Strauma medulla cystica suprarenalis<br>Streptococcus peritonitis | The fixing solution when tested showed large quantities of adrenalin |
| Kswashima 1911 | 33 F | Left Apricot | Puerperal fever following delivery of a 6 mos. macerated fetus | Chromaffin cell tumor<br>Thrombophlebitis right ovarian vein<br>Status puerperalis<br>Fatty heart<br>Neurofibromatosis | The author believed the tumor was of malignant nature. There were no metastases |
| Herde 1912 | 45 F | Left 3 cm.<br>Right 1 cm. | Myocardial degeneration | Chromaffin cell tumor<br>Small white kidneys<br>Cardiac hypertrophy with thrombosis of left ventricle<br>Pulmonary œdema | This author observed 2 cases in 700 necropsies |
| Wegelin-Bern 1912 | 39 F | Right 5 cm. | Chronic pulmonary tuberculosis | Pheochromocytoma<br>Subendocardial thrombosis<br>Myocardial fibrosis<br>Renal infarcts | Extract from tumor gave strong chemical reactions of adrenalin |
| Thomas 1915 | 80 F | Left 4–4½ cm. | Pulmonary embolism | Chromaffin cell tumor<br>Fibro-endocarditis<br>Hypertrophy left heart<br>Hydrothorax<br>Pulmonary infarct | This aged patient was seen terminally but the author stated that there was nothing in the clinical history suggestive of hyperadrenalæmia |
| Bergstrand 1920 | 50 F | Right 8–5 cm. | Influenza | Pheochromocytoma<br>Hypertrophy of heart<br>Pneumonia | The history before the onset of pneumonia was not given |
| Laignel-Lavastine and Aubertine 1908 | 33 M | Right Pea | Pulmonary tuberculosis<br>Cachexia<br>Melonodermia with no pigmentation or asthenia (B. P. 140) | "Medullary adenoma of suprarenal capsule"<br>Advanced pulmonary tuberculosis | The chromaffin reaction was not demonstrated. The author believed this tumor had its origin in chromaffin tissue but in no place was the tumor connected with the medulla of the gland |
| Reimer 1927 | 24 | 2 cm. | Addison's disease | "Paraganglioma of suprarenal capsule" | This was probably a cortical tumor |
| Kutschera-Aichbergen (Paul—1931) | 72 F | Bilateral Right 200 grams Left Hazelnut | Cardiac insufficiency<br>Hypertension<br>Nephrosclerosis | Chromaffin cell tumor<br>Hypertrophy of heart (marked)<br>Small white kidneys | The brief history indicating periodic attacks of dizziness and headaches was perhaps insignificant in this case |
| Paul 1931 | 23 F | Right 85 grams | Suicide from poison<br>Acute pulmonary œdema<br>Glycosuria | Chromaffin cell tumor | This patient was known to have suffered from angina-like attacks |
| Paul 1931 | 54 M | Right 6 cm. | No clinical diagnosis<br>Pressure symptoms in epigastrium, Cyanosis, vomiting | Chromaffin cell tumor<br>Hypertrophy of heart<br>Large kidneys but not diseased | The author regarded case as acute epinephrine poisoning |
| Jaffee' (Paul—1931) | 25 F | Left 5 cm. | Normal delivery<br>Died in shock | Chromaffin cell tumor<br>Moderately enlarged heart | Again showing great susceptibility to shock |
| Paul 1931 | 55 M | Left 250 grams | Bronchitis, emphysema, cirrhosis of liver, hypertension | Chromaffin cell tumor<br>Cirrhosis of liver<br>Acute pulmonary œdema<br>Hypertrophy of heart<br>Generalized arteriosclerosis | Fixing solution was tested immediately for adrenalin and found to be positive |
| Paul 1931 | 62 F | Left 3 cm. | None | Chromaffin cell tumor<br>Lobar pneumonia<br>Enlarged heart<br>Thrombosis of inferior vena cava<br>Cholecystitis | |

TABLE II.—CASES WITH MALIGNANT NEOPLASTIC TUMORS

| Author Date | Age Sex | Location—size Primary tumor | Clinical diagnosis | Pathological diagnosis |
|---|---|---|---|---|
| Wahl 1914 | 2½ F | Left 6–4 cm. | Abdominal tumor Anæmia | Neuroblastoma with metastases to liver, kidneys, suprarenal and lymph glands<br>Ganglioneuroma<br>Paraganglioma |
| Herxheimer 1914 | 55 M | Right 1 cm. | Neurofibromatosis Syphilis Large tumor of sacrum | Neurofibromatosis with sarcomatous degeneration<br>Tumor in region of cauda equina connected anteriorly with abdominal tumor size of child's head<br>Paraganglioma |
| Harbitz 1915 | 47 M | Left 6–7 cm. | Abdominal neoplasm | Hypernephroma replacing kidney and extending from spine of ileum to diaphragm with metastases to liver and lungs<br>Cystadenoma of the pancreas.<br>Hæmangioma?<br>Chromaffin cell tumor |
| Bonnamour et al 1927 | * | | | Suprarenal paraganglioma with metastatic pachypleurisy |
| Russum and Barry 1930 | 56 M | Left 1½ cm. | Neurofibromatosis Lobar pneumonia Palpable tumor in region of right kidney | Acute lobar pneumonia<br>Retroperitoneal sarcoma (right) lumbar region<br>Neurofibromatosis<br>Colloid adenoma thyroid gland<br>Sarcoma mediastinum<br>Atherosclerosis of aorta and thrombosis left ventricle of heart<br>Paraganglioma |
| King 1931 | 30 M | Bilateral Left—1–½ in. Right "smaller" | Subcutaneous nodules (biopsy) "Secondary carcinoma" | Malignant pheochromocytoma with metastases in liver, lungs, bowel, bones, skin, and aortic gland |
| Lazarus and Eisenberg 1932 | 58 | Bilateral 2 x normal size | Adenoma of thyroid gland Sarcoma of the gum (biopsy) | Papillary adenocarcinoma of the thyroid gland without metastases<br>Paraganglioma (suprarenal) malignant with generalized metastases |
| Lasagna, F. 1910 | 61 M | Bilateral Right 9–4½ cm. Left 1 cm. | General marasmus | Atypical hypernephroma (showed considerable chromaffin reaction) |

*No clinical information given.

Additional pathological findings were: Hæmorrhagic exudate in lungs, hypertrophic dilatation of the left ventricle of the heart, and chronic nephritis with glomerular sclerosis of mild degree.

Porter and Porter, 1930, described another case of "suprarenal sympathetic syndrome" in which surgical intervention was successful. In this case a clinical diagnosis of a probable chromaffin cell tumor was made, purely on the basis of the clinical symptoms. This diagnosis, however, was not confirmed by two pathologists at that time, but subsequent studies have undoubtedly established the diagnosis of pheochromocytoma. Drs. Porter and Porter obligingly permitted us to study sections from this tumor in collaboration with Dr. V. L. Andrews.

CASE 7. A man, aged 39 years, complained of peculiar attacks occurring apparently without reason at irregular intervals. Gradually the patient noticed that by assuming certain positions he was able to produce them at will. Within a few minutes after assuming the position the attack was ushered in by a peculiar sensation in his epigastrium. His systolic blood pressure would rise from 110 to 200 millimeters mercury or more within a period of 90 seconds. His heart would slow down to about 55 with an unusual, forcible beat, sufficient to shake the bed or chair that he was occupying. His color was ashen and he "felt terrible." As the months passed, mild renal degeneration signs gradually manifested themselves. In addition mild cardiac embarrassment was noticed, shown by slight dyspnœa on exertion, occasional tendency to tachycardia following the "attacks" and a very greatly increased disability and discomfort following the period of hypertension. Exploratory laparotomy revealed a movable retroperitoneal tumor above the right kidney. The tumor was removed with little difficulty and without much hæmorrhage. The patient was put to bed in a state of severe shock, which, in spite of active medication, continued for more than 24 hours. The patient recovered, however, and has been free from his symptoms up to the present time.

### ANALYSIS OF OTHER REPORTED CASES

Lazarus and Eisenberg, 1932, reported 2 cases. One was associated with malignancy (Table II). The details of this case have been more completely described in a later publication. The other case was that of a woman, aged 58, in which the patient's symptoms were all referable to the genito-urinary tract

(see Table III). The history in this case did not show any evidence of the syndrome here described although careful observations were recorded.

Hick has recently reported a case which he describes as a "suprarenalin-producing pheochromocytoma of the suprarenal gland" (Table III). The tumor, however, was extra suprarenal "attached to the left suprarenal gland by a short fibrous pedicle." The microscopic diagnosis was "pheochromocytoma in the region of the left suprarenal gland." According to Pick, this tumor would be classed as a paraganglioma.

Other reported cases of benign chromaffin cell tumors unassociated with malignant neoplastic growths did not contain clinical histories and physical examinations. In the literature these cases were found in pathological reports of necropsy findings and for that reason only the clinical diagnoses were given. The essential information in these cases can be given in tabular form. No conclusions, however, regarding the clinical symptomatology can be inferred (Table I).

The pheochromocytomata, as has already been shown, are benign tumors and do not give rise to metastases. However, it is probable that the more undifferentiated pheochromoblastic type of cells may give rise to the rare malignant tumors sometimes called malignant pheochromocytomata. The case of King illustrates this point. The original suprarenal tumor showed cells which took the chromaffin reaction but the metastatic growths did not show this reaction with the exception of a few scattered cells. The metastatic cells also appeared to be much less differentiated in type than those showing the chromaffin reaction found in the original tumor. For these malignant tumors the term pheochromoblastoma would probably be more appropriate.

The cases with malignant neoplastic growth as evidenced by metastases or associated with definite malignancy in other organs are given in tabular form. None of these cases presented clinical symptoms resembling the syndrome here described (Table II).

It is difficult to evaluate the reports of the earlier cases of supposedly chromaffin cell tumors which were reported under a different histopathological diagnosis and in which neither histories nor physical examinations were available. In fact many of the cases which have been considered by certain authors to have been chromaffin cell tumors were doubtful even as to the pathological identity of the tumors. It is possible that one of the earliest cases of chromaffin cell tumor described was that of Frankel (1886).

A young girl, aged 18 years, who had been suffering from attacks of cardiac palpitation, anguish, dizziness, and headache (these attacks usually lasted only a few minutes) finally developed weakness, pulse of high tension, vomiting, albumin, a few casts in the urine, and frequent epistaxis. Death occurred suddenly in collapse.

At the necropsy both kidneys appeared normal but there were hæmorrhages in the renal pelves, the mucous membrane of the small intestines, the media and adventitia of the pulmonary artery, likewise into the endocardium and superficial muscular layers of the left ventricle. Bilateral tumors of the suprarenal glands were found. The tumor of the left suprarenal was about the size of the fist while that of the right was the size of a hazelnut. The pathological diagnosis was thought to be angiosarcoma of the left suprarenal capsule and sarcoma of the right. The description of the latter tumor convinced certain French authors (Azemar and Peyron) that it was undoubtedly a chromaffin cell tumor.

Herxheimer mentions a case of Perley' 1890, who described a tumor which he called an angiosarcoma of the right suprarenal gland in a man aged 68 years. Herxheimer believed that this was probably a chromaffin cell tumor.

Berdez, 1892, described a tumor found accidentally at autopsy in a 70 year old man who had died from pneumonia. The tumor was 2.5 centimeters by 3.5 centimeters, firm consistency, brown color, and very vascular. The mass was ovoid in shape and occupied the principal part of the right suprarenal gland. The author believed the tumor arose from the medulla of the gland. Zeckwer considered it to be a pheochromocytoma.

Manasse, in 1893, described a dark brown tumor which was found accidentally at autopsy in the left suprarenal gland of an "old" woman who had died from tuberculosis. Rabin believed that this tumor showed the characteristics of a pheochromocytoma.

TABLE III

| Author Date | Age Sex | Tumor location and size | Chief points in clinical information | Operative procedure or cause of death | Remarks |
|---|---|---|---|---|---|
| Kolisko (Neusser and Wiesel) 1910 | 43 M | Right 9–7–6 cm. | Abscessed tooth<br>Attacks of severe headaches | Tooth extraction under local anæsthesia (cocaine 2½ per cent) | Patient expired from shock. Necropsy revealed pulmonary œdema, hypertrophy of the heart<br>Extract from tumor contained large quantities of adrenalin |
| Herde 1912 | 62 F | Right 7–6 cm. | Myocarditis<br>Arteriosclerosis<br>Diabetes | Amputation of gangrenous extremity | Patient expired apparently from shock. Necropsy revealed a cystic suprarenal tumor with alveolar arrangement of its cells which showed the specific chromaffin reaction |
| Helly 1913 | 43 M | Right 6 cm. | Heart trouble thought to be nervous in origin<br>Severe hypertension without evidence of nephritis<br>Hæmorrhoids<br>Glycosuria | Hæmorrhoidectomy under local anæsthesia (novocaine) | Patient died following operation<br>Necropsy: Chromaffin tumor, hypertrophy of the heart, œdema of lungs |
| Orth 1914 | 47 M | Right Duck egg | B.P. 230/120 mm. Hg.<br>Albumin and casts in urine<br>Enlarged heart | None | Only cause of death revealed at the postmortem examination was the "paraganglioma." The tumor contained large amounts of epinephrine |
| Masson and Martin 1923 | 45 F | Right Large kidney | ? Tumor of gall bladder<br>"Frequent attacks of suffocation" | Attempt to remove tumor | Only a biopsy was obtained. The patient was in "violent shock disproportionate to the length of the operation and the quantity of blood lost" |
| Biebl and Wichels 1925 | 36 M | Bilateral | Hypertension<br>Multiple apoplexies<br>Diabetes and chronic nephritis (Glycosuria and albuminuria) | None | In attempting to explain the symptoms of the patient during life on the basis of the complete necropsy findings, these authors regarded it as a case of chronic adrenalin poisoning |
| Zeckwer 1925 | 56 F | Left 4–3–2.5 cm. | Cardiovascular syphilis<br>(Past history not reported) | Died in convulsions | Necropsy: Neurofibromatosis of spinal nerves<br>Syphilitic aortitis with pulmonary œdema |
| Oberling and Jung 1927 | 28 F | Left Large kidney | Variable hypertension<br>Pregnancy<br>Violent headaches | Normal delivery | Within 6 hours patient died in shock<br>The kidneys showed no significant pathology<br>There was a voluminous heart |
| Von der Muhll (Roux) 1928 | 33 F | Right Orange | "Periodic discomforts"<br>Dizziness with nausea<br>? Primary tumor of the liver | Exploratory | Tumor was successfully extirpated. The patient made a good recovery and was free from her former attacks |
| Wichels and Biebl 1928 | 33 M | Right Hen's egg | "Epileptiform attacks"<br>Glycosuria and albuminuria<br>Brown pigmentation of face and arms<br>Mild hypertension. B.P. was never taken during an attack<br>Headaches, dyspnœa, and tachycardia | None | Necropsy: Hypertrophy of heart. No evidence of nephritis. Authors believed patient's symptoms were due to hyperadrenalæmia |
| Schroeder 1928 | 42 F | Bilateral Apple | Hypertension. Periodic diaphoresis with polyuria, malaise, and fatigue.<br>Enlarged heart. Glycosuria which would not respond to insulin | Patient died from bronchopneumonia | Necropsy: Generalized arteriosclerosis.<br>Hypertrophy of heart. Studies on the suprarenal tumor revealed large quantities of adrenalin |
| Barker 1930 | 47 M | Left | Epileptiform convulsions<br>B.P. 200/114. Enlarged heart<br>Evidence of a cerebral lesion | Cerebral hæmorrhage | This patient was seen late when his psyche was too disturbed to permit of reliable answers to questions. Necropsy: General arteriosclerosis with cerebral hæmorrhage and bronchopneumonia |
| Paul 1931 | 18 M | Right Hen's egg | Periodic attacks of nausea and vomiting with headaches. Motor disturbances with short periods of amnesia<br>B.P. ranged from 185 to 207mm.Hg systolic | ? Uræmia | Necropsy: Hypertrophy of heart<br>Mild kidney damage |
| Paul 1931 | 40 M | Right Fist | Periodic attacks of dizziness, headaches, and vomiting. Elevated hypertension. When seen in a terminal attack his pupils became dilated and his entire body became red | ? Atropine poisoning | It was thought the patient possibly had been given medicine by mistake and a tentative diagnosis of atropine poisoning was made. A legal postmortem examination with chemical analysis of stomach contents failed to substantiate this theory |
| Lazarus and Eisenberg 1932 | 58 F | Left | Pain in left flank, dysuria, polyuria, and nocturia | Tumor successfully removed | The patient made an uneventful recovery |
| Hick 1933 | 64 F | Left 4—2 cm. | Hypertension. This patient was seen terminally following a cerebral accident | Cerebral hæmorrhage | An extract was made from the tumor and proved to contain epinephrine |

Robert, 1899, described a case, according to Azemar, in which the patient was a male, aged 46 years, with arterial hypertension and a suprarenal tumor. An attempt to remove the tumor surgically proved fatal to the patient. The description of the pathological findings at autopsy convinced Peyron and Azemar that this was also a case of pheochrome tumor of the suprarenal medulla.

A case mentioned by Neusser and Wiesel was that of Wiesel in 1909. The patient was a 2½ year old child with a chromaffin tumor of the suprarenal gland and advanced arteriosclerosis identically similar to those produced experimentally by the injection of epinephrine.

Bonnamour, Doubrow, and Montegue mentioned a case of Graviar and Bernheim which was said to have been malignant.

Connor mentioned that he had seen 2 cases. Ewing stated in his textbook that he had seen a case. Geschickter, in a personal communication, stated that he had seen sections from a case which showed metastases to bones.

Pheochrome tumors are known to occur in animals. Several interesting pathological studies upon these tumors found in animals have been recently reported.

## DEDUCTIONS

Although the incidence of the pheochromocytomata is relatively rare, it may be that when the attention of the profession is directed to them their rarity may be more apparent than real. No doubt many of these cases of pheochromocytomata have been diagnosed incorrectly from the histopathological viewpoint. The clinical symptomatology plus the chromaffin reaction are material aids to the pathologist in arriving at the diagnosis. In regard to the chromaffin reaction, the tissues should be fixed in bichromate solution immediately, for the reaction is destroyed by other fixing solutions. The quantitative chemical examination of the tumor tissue should be carried out immediately, due to the rapidity with which adrenalin oxidizes.

The close relationship that is known to exist between the suprarenal medulla and the thyroid gland is borne out in the study of these tumors. Many of the patients' symptoms were similar to those seen in hyperthyroidism. In fact several cases have been operated upon for goiter while many were shown to have had pathological changes in the thyroid gland at necropsy. That the patients' symptoms, however, were independent of abnormalities in the thyroid gland is shown by numerous cases in which were present the typical syndrome without demonstrable pathological lesions in these glands. Another interesting fact is that the chromaffin tumors do not give rise to the clinical states known as the polyglandular syndrome in which there are somatic changes. There were also no cases presenting a clinical similarity to those recently described by Dr. Harvey Cushing as "pituitary basophilism." The hypertension, glycosuria, weakness, and occasional erythræmia were the only similar findings, and these, as has already been seen in the case of chromaffin tumors, are a part of a generalized sympatheticotonia. Whether these symptoms, in the cases of basophilic adenoma of the pituitary, are dependent upon an associated activity of the secondary endocrine organs, such as the suprarenal medullary sympathetic mechanism, is a matter of conjecture.

In the study of pheochrome tumors, the question of possible hyperchromaffinism in the absence of a tumor of the medullary substance, presented itself. Recently there has been considerable evidence brought forward in favor of this possibility. The similarity of the symptoms-complex of certain cases recently described as "non-goiterous hyperthyroidism" to the "suprarenal sympathetic syndrome" here described, lends further evidence for speculation as to the etiological factors involved in producing these clinical states. Again there have been certain tumors of the suprarenal cortex described in the literature which have had signs and symptoms unexplained on the basis of the main lesion but could be more logically attributed to the definite hyperplasias of the chromaffin tissue found in those cases.

## MECHANISM OF SYNDROME

From the personal case presented and a majority of those cases here reviewed in which

there was sufficient clinical information, it is obvious that there is associated with these benign suprarenal pheochrome tumors a definite clinical syndrome. It would appear reasonable that there is a causal relationship between these tumors and the symptomatology presented by the patients in whom they are found. Whatever the cause, the symptoms of these patients are undoubtedly produced through the mechanism of the sympathetic nervous system.

The large quantity of epinephrine recovered from the tumor in our case, together with the clinical symptoms of the patient during life, offers considerable evidence that cannot be discarded lightly in attempting to explain the mechanism by which these tumors produce an excessive stimulation of the sympathetic nerve endings. It is known that "epinephrine stimulates the sympathetic nerves and produces a variety of effects dependent upon the function of the several structures supplied by the nerves." In sufficient dosage and under certain experimental conditions this drug has been shown to produce a sudden increase in blood pressure, glycosuria, tachycardia, vasoconstriction followed by vasodilatation of peripheral vessels, a sensation of heat, fever, nausea, vomiting, exophthalmos, diaphoresis, mydriasis, nervousness, urinary suppression followed by polyuria, pulmonary œdema, shock and death; hæmorrhages into the liver, lungs, kidneys, mucosa of the gastro-intestinal tract, and the central nervous system; hypertrophy of the heart and various vascular lesions.

It can be readily seen that it would be possible to explain all the outstanding signs and symptoms, as well as the postmortem findings, of these patients on the basis of the release into the blood stream of excessive quantities of epinephrine.

The contention that these tumors are actively secreting and that the clinical states associated with them are in fact an "hyperadrenalæmia" has been maintained recently by numerous authors. Chemical proof of this is lacking, since present methods are not delicate enough to demonstrate chemically an hyperadrenalæmia. However, it is clear that the syndrome is produced through the mechanism of the sympathetic nervous system, a system closely related developmentally and functionally to the suprarenal medullary tissue, the seat and origin of the pheochromocytomata.

It was due to these facts that we chose to call the clinical states associated with medullary pheochrome tumors the "suprarenal sympathetic syndrome" in contradistinction to the "suprarenal genital syndrome" which is associated with certain neoplasms of the cortical portion of these glands.

## SUMMARY AND CONCLUSIONS

1. A personal case of pheochromocytoma, the largest tumor of this type yet described in the literature, has been reported.

2. These tumors arise from certain mature adult cells of the suprarenal medulla. These specific cells assume a brown color when treated with chrome salts and for that reason are called chromaffin cells or pheochromocytes. It is these cells which produce adrenalin. The terms used to designate the tumors arising from the pheochromocytes are: paraganglioma and pheochromocytoma. The term pheochromocytoma is preferable since it is descriptive of the predominating type of cell.

3. The available clinical facts associated with the pheochromocytomata have been brought together and summarized in detail.

4. A comparison of all the other reported cases of pheochromocytoma in which clinical histories and physical examinations were given showed a striking similarity in symptomatic and pathological data. The typical clinical features of this syndrome are: Hypertension or paroxysmal hypertension, glycosuria, evidences of instability of the sympathetic nervous system, such as periodic attacks of sympatheticotonia with tachycardia and vasoconstriction followed by vasodilatation as shown by pallor, followed by flushing of the skin; nausea, vomiting, headaches, nervous manifestations with sensations of constriction in the epigastrium, dyspnœa, suffocation or choking, attended by an increased susceptibility to shock and pulmonary œdema.

5. Further analysis of these cases disclosed that the patients were all adults. There was

occurrence in both male and female, about equal number. The size of the tumor varied from 3 grams to 100 grams. These tumors were benign and had a tendency to become cystic and undergo necrosis and hæmorrhage. When examined chemically they were shown to contain excessive quantities of adrenalin.

6. When surgical removal of the tumor was successful it completely relieved the patient of all signs and symptoms typical of this syndrome.

7. For the association of pheochromocytoma of the suprarenal medulla with clinical evidences of instability of the sympathetic nervous system, we have chosen the descriptive term "suprarenal sympathetic syndrome."

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TABLE III

| Author Date | Age Sex | Tumor location and size | Chief points in clinical information | Operative procedure or cause of death | Remarks |
|---|---|---|---|---|---|
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| Herde 1912 | 62 F | Right 7–6 cm. | Myocarditis<br>Arteriosclerosis<br>Diabetes | Amputation of gangrenous extremity | Patient expired apparently from shock. Necropsy revealed a cystic suprarenal tumor with alveolar arrangement of its cells which showed the specific chromaffin reaction |
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| Orth 1914 | 47 M | Right Duck egg | B.P. 230/120 mm. Hg.<br>Albumin and casts in urine<br>Enlarged heart | None | Only cause of death revealed at the postmortem examination was the "paraganglioma." The tumor contained large amounts of epinephrine |
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Pheochrome tumors are known to occur in animals. Several interesting pathological studies upon these tumors found in animals have been recently reported.

## DEDUCTIONS

Although the incidence of the pheochromocytomata is relatively rare, it may be that when the attention of the profession is directed to them their rarity may be more apparent than real. No doubt many of these cases of pheochromocytomata have been diagnosed incorrectly from the histopathological viewpoint. The clinical symptomatology plus the chromaffin reaction are material aids to the pathologist in arriving at the diagnosis. In regard to the chromaffin reaction, the tissues should be fixed in bichromate solution immediately, for the reaction is destroyed by other fixing solutions. The quantitative chemical examination of the tumor tissue should be carried out immediately, due to the rapidity with which adrenalin oxidizes.

The close relationship that is known to exist between the suprarenal medulla and the thyroid gland is borne out in the study of these tumors. Many of the patients' symptoms were similar to those seen in hyperthyroidism. In fact several cases have been operated upon for goiter while many were shown to have had pathological changes in the thyroid gland at necropsy. That the patients' symptoms, however, were independent of abnormalities in the thyroid gland is shown by numerous cases in which were present the typical syndrome without demonstrable pathological lesions in these glands. Another interesting fact is that the chromaffin tumors do not give rise to the clinical states known as the polyglandular syndrome in which there are somatic changes. There were also no cases presenting a clinical similarity to those recently described by Dr. Harvey Cushing as "pituitary basophilism." The hypertension, glycosuria, weakness, and occasional erythræmia were the only similar findings, and these, as has already been seen in the case of chromaffin tumors, are a part of a generalized sympatheticotonia. Whether these symptoms, in the cases of basophilic adenoma of the pituitary, are dependent upon an associated activity of the secondary endocrine organs, such as the suprarenal medullary sympathetic mechanism, is a matter of conjecture.

In the study of pheochrome tumors, the question of possible hyperchromaffinism in the absence of a tumor of the medullary substance, presented itself. Recently there has been considerable evidence brought forward in favor of this possibility. The similarity of the symptoms-complex of certain cases recently described as "non-goiterous hyperthyroidism" to the "suprarenal sympathetic syndrome" here described, lends further evidence for speculation as to the etiological factors involved in producing these clinical states. Again there have been certain tumors of the suprarenal cortex described in the literature which have had signs and symptoms unexplained on the basis of the main lesion but could be more logically attributed to the definite hyperplasias of the chromaffin tissue found in those cases.

## MECHANISM OF SYNDROME

From the personal case presented and a majority of those cases here reviewed in which

there was sufficient clinical information, it is obvious that there is associated with these benign suprarenal pheochrome tumors a definite clinical syndrome. It would appear reasonable that there is a causal relationship between these tumors and the symptomatology presented by the patients in whom they are found. Whatever the cause, the symptoms of these patients are undoubtedly produced through the mechanism of the sympathetic nervous system.

The large quantity of epinephrine recovered from the tumor in our case, together with the clinical symptoms of the patient during life, offers considerable evidence that cannot be discarded lightly in attempting to explain the mechanism by which these tumors produce an excessive stimulation of the sympathetic nerve endings. It is known that "epinephrine stimulates the sympathetic nerves and produces a variety of effects dependent upon the function of the several structures supplied by the nerves." In sufficient dosage and under certain experimental conditions this drug has been shown to produce a sudden increase in blood pressure, glycosuria, tachycardia, vasoconstriction followed by vasodilatation of peripheral vessels, a sensation of heat, fever, nausea, vomiting, exophthalmos, diaphoresis, mydriasis, nervousness, urinary suppression followed by polyuria, pulmonary œdema, shock and death; hæmorrhages into the liver, lungs, kidneys, mucosa of the gastro-intestinal tract, and the central nervous system; hypertrophy of the heart and various vascular lesions.

It can be readily seen that it would be possible to explain all the outstanding signs and symptoms, as well as the postmortem findings, of these patients on the basis of the release into the blood stream of excessive quantities of epinephrine.

The contention that these tumors are actively secreting and that the clinical states associated with them are in fact an "hyperadrenalæmia" has been maintained recently by numerous authors. Chemical proof of this is lacking, since present methods are not delicate enough to demonstrate chemically an hyperadrenalæmia. However, it is clear that the syndrome is produced through the mechanism of the sympathetic nervous system, a system closely related developmentally and functionally to the suprarenal medullary tissue, the seat and origin of the pheochromocytomata.

It was due to these facts that we chose to call the clinical states associated with medullary pheochrome tumors the "suprarenal sympathetic syndrome" in contradistinction to the "suprarenal genital syndrome" which is associated with certain neoplasms of the cortical portion of these glands.

## SUMMARY AND CONCLUSIONS

1. A personal case of pheochromocytoma, the largest tumor of this type yet described in the literature, has been reported.

2. These tumors arise from certain mature adult cells of the suprarenal medulla. These specific cells assume a brown color when treated with chrome salts and for that reason are called chromaffin cells or pheochromocytes. It is these cells which produce adrenalin. The terms used to designate the tumors arising from the pheochromocytes are: paraganglioma and pheochromocytoma. The term pheochromocytoma is preferable since it is descriptive of the predominating type of cell.

3. The available clinical facts associated with the pheochromocytomata have been brought together and summarized in detail.

4. A comparison of all the other reported cases of pheochromocytoma in which clinical histories and physical examinations were given showed a striking similarity in symptomatic and pathological data. The typical clinical features of this syndrome are: Hypertension or paroxysmal hypertension, glycosuria, evidences of instability of the sympathetic nervous system, such as periodic attacks of sympatheticotonia with tachycardia and vasoconstriction followed by vasodilatation as shown by pallor, followed by flushing of the skin; nausea, vomiting, headaches, nervous manifestations with sensations of constriction in the epigastrium, dyspnœa, suffocation or choking, attended by an increased susceptibility to shock and pulmonary œdema.

5. Further analysis of these cases disclosed that the patients were all adults. There was

occurrence in both male and female, about equal number. The size of the tumor varied from 3 grams to 100 grams. These tumors were benign and had a tendency to become cystic and undergo necrosis and hæmorrhage. When examined chemically they were shown to contain excessive quantities of adrenalin.

6. When surgical removal of the tumor was successful it completely relieved the patient of all signs and symptoms typical of this syndrome.

7. For the association of pheochromocytoma of the suprarenal medulla with clinical evidences of instability of the sympathetic nervous system, we have chosen the descriptive term "suprarenal sympathetic syndrome."

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# ACUTE OSTEOMYELITIS

## A Clinical and Experimental Study[1]

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EARLY diagnosis and treatment is as important in osteomyelitis as in appendicitis because, in the former, a policy of watchful waiting often leads to an unnecessarily extensive destruction of bone, and sometimes even to loss of life. As the earliest stages of osteomyelitis are understood rather imperfectly, we have attempted, through a clinicopathological study of early cases, and by means of animal experimentation, to fill in the gaps in our knowledge of this subject.

One of the earliest pictures of acute osteomyelitis was given by Starr who stated: "Infection starts in the metaphysis or diaphyseal side of the epiphyseal line; it extends most easily along the epiphyseal line to the cortex and the periosteum; it readily and early strips the periosteum, with increasing tension as more pus is formed; with increased tension the infection probably spreads backward through the haversian canals at various levels, and invades the medulla from the cortex, giving this spotty character to the shaft infection." A somewhat different view of the development of acute osteomyelitis is advanced by Wilensky who advocates the "mechanistic theory." He regards the necrosis of bone as the result of emboli which lodge in various vessels of the bone, causing their thrombosis. He states further: "The various pathologic pictures that result depend upon the size of the plugged vessel, the relative position of the plug, the powers of vascular anastomosis, the capabilities for development of collateral circulation, in conjunction with the character, virulence, etc. of bacteria giving rise to the infection." Thus he explains the involvement of an entire bone as the result of the plugging of the main nutrient artery, and the necrosis of one half of the bone as caused by a thrombosis of one of the two main branches of the nutrient artery. Smaller areas of infection are thought to result from the lodgement of bacterial emboli in smaller vessels.

### EXPERIMENTS

The study of operative material in acute osteomyelitis gives but a fragmentary view of an inflammatory process which has been going on for several days or even weeks. For this reason we turned to animal experimentation to clarify the earliest pathological changes. Limited space permits only a statement of the method used and a summary of the results obtained.

### METHOD

An acute osteomyelitis was produced in 33 rabbits by the insertion of a culture of Staphylococcus aureus through a hole drilled in the tibia near its upper end. The development of infection in the bone was followed by the daily recording of the animal's temperature and by weekly X-ray pictures. The animals were killed at various periods from 1 day to 6 months following the operation. It was possible to make microscopic sections of the entire upper half of the tibia and thus to observe all the stages of infection and the defense processes called forth.

### RESULTS

The changes which take place following the experimental introduction of infection into a long bone may be summarized in the following manner:

1. The blood vessels become engorged and the bacteria are walled off by fibrin, pus cells, macrophages, and fatty tissue forming definite zones in the order named, from within outward (*A*, *B*, *C*, *D*, Fig. 1).

2. Newly formed bone (involucrum) which appears after 1 week, comprises the outer shell of the defensive wall, and also replaces necrotic bone (*E*, Fig. 1).

[1]This work has been conducted under a grant from the Christine Breon Fund for Medical Research of the University of California.

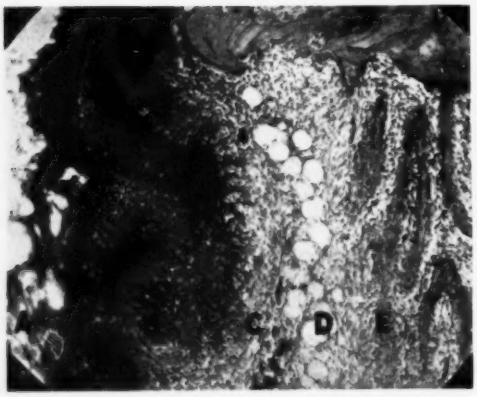


Fig. 1. Microscopic section through the wall of an abscess in a rabbit's tibia, 7 days after infection with Staphylococcus aureus. *A*, Fibrin; *B*, pus cells; *C*, macrophages; *D*, fatty tissue; *E*, involucrum.

Fig. 2. Microscopic section through the cortex overlying an abscess in a rabbit's tibia, 14 days after infection with Staphylococcus aureus. *A*, Dead cortex; *B*, living cortex; *C*, thrombosed haversian canal; *D*, an enlarged haversian canal separating the dead from the living cortex.

3. The separation of dead bone (sequestrum) from the living cortex takes place after 2 or 3 weeks by means of a thrombosis of the vessels in the haversian canals which in turn become enlarged and invaded by connective tissue and osteoclastic cells (*A*, *B*, *C*, *D*, Fig. 2).

4. The bone marrow is replaced by fibrous tissue containing many fat cells.

5. In the chronic stage the contour of the bone is restored by involucrum, and the sequestra float unattached in an abscess cavity (Fig. 3).

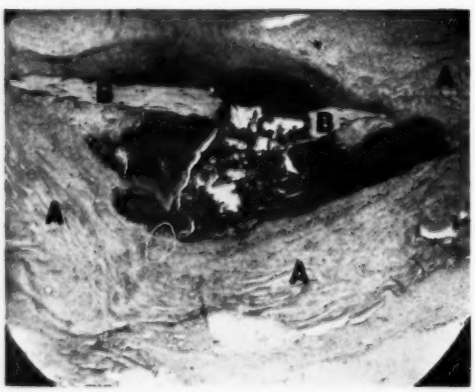


Fig. 3. Microscopic section of a rabbit's tibia, 21 days after infection with Staphylococcus aureus. *A*, Involucrum; *B*, sequestra; *C*, abscess cavity.

CLINICAL STUDY

Certain cases of acute osteomyelitis were given rather careful clinical and pathological examinations in the hope that a diagnosis might be made as early as possible and that treatment might rest on a sound basis.

CASE 1. E. G., a girl, 4 years of age, entered the hospital because of pain and swelling over the lower half of the right tibia of 4 days' duration. The temperature on entry was 40 degrees C. and the white cell count 21,000. At operation, 5 days after the onset of symptoms, a large subperiosteal abscess was found on the medial side of the tibia over its distal half. This abscess was packed open with Dakin's tubes and gauze, but the cortex was not opened. A culture of the pus gave a growth of Staphylococcus aureus, and on the day after operation, the same organism was found in the blood stream. An X-ray examination made on the seventh day of the disease showed an area of slight rarefaction in the lower end of the right tibia just above the epiphyseal line (Fig. 4). The patient died on the following day, at which time there were signs of meningitis. At autopsy the lower fourth of the tibia was removed, and large microscopic sections were made by the celloidin method.

A careful inspection of one of these microscopic sections tells the story of acute osteomyelitis. In Figure 5, the central photograph shows the microscopic section in its approximately normal dimensions and corresponds to the distal one and one-half inches of the tibia, a roentgenogram of which comprises Figure 4. Surrounding the central picture are six photographs in various degrees of magnification, corresponding to fields enclosed by the respective dotted rectangles. At C, one sees normal cortex

covered with periosteum and lying over marrow which also is free from infection. Nearer the epiphyseal line, at A, a pus filled haversian canal penetrates the cortex and carries the infection outward from the cancellous bone to the subperiosteal region. The opposite cortex, at D, shows numerous perforations through which infection has passed with a resultant large subperiosteal abscess and stripping of the periosteum. B, pictures a wave of pus surging up the marrow cavity. There is no defensive wall of granulation tissue between the infected and normal marrow.

About two-thirds of the epiphyseal line has been destroyed by the infection, the point of transition between the normal and diseased epiphyseal plate being shown at F. The cartilage of the ankle joint remains intact although the epiphysis is infiltrated with pus cells. In E, the oil immersion lens reveals large clumps of staphylococci scattered through the cancellous bone near the epiphyseal line, at which point the infection probably first began to develop.

This child evidently succumbed to an overwhelming infection to which little defense was offered. In the absence of early drainage of the medullary cavity, the increasing pressure threw many staphylococci into the blood stream and produced an extreme toxæmia. This case showed the usual origin of the infection on the shaft side of the epiphyseal line, followed by a perforation of the overlying cortex and the production of a subperiosteal abscess.

Fig. 4. Case 1. Roentgenogram of the distal two-thirds of tibia, 7 days after the onset of symptoms.

Case 2. This resembled the first case in several respects. R. M., a boy 8 years of age, was seen 6 days after the onset of pain, swelling, and tenderness over the lower half of the left tibia. One week before these symptoms began, the patient had received a deep laceration over the left knee which healed without apparent infection. On entry the patient's temperature was 38.4 degrees C., and his white cell count was 22,000. A blood culture taken on entry showed Staphylococcus aureus. Roentgenograms of both tibiæ 6 days after the onset of symptoms gave definite evidence (rarefaction of cancellous bone) of an osteomyelitic process just above the distal epiphyseal line of the left tibia.

An incision was made over the lower end of the left tibia, opening into a large subperiosteal abscess. When the medullary cavity was drilled into, it was found to contain pus under pressure and this was drained by removing a window of cortex 1.5 inches long and ½ inch wide. A vaseline pack was inserted and a cast was applied.

After an initial fall in temperature, a daily swing to between 39 degrees C. and 40 degrees C. persisted for 1 week during which an abscess appeared over the upper end of the tibia. Following the drainage of this abscess, the temperature fell to normal, and the patient improved steadily. Four months later, large sequestra were removed from both ends of the tibia after which the wound filled in rapidly with granulation tissue.

A microscopic examination of the piece of cortex removed at the first operation showed the extension of an infected thrombus through a large haversian canal. A culture and smear of the pus found at operation showed Staphylococcus aureus. Re-examination of the blood 5 days after operation indicated the disappearance of this organism from the blood stream.

Case 3. E. D., a boy 2 years of age, presented a similar picture 1 week after the onset of pain and swelling over the medial aspect of the lower third of the right leg. These symptoms appeared a few days after a sore throat and fever had been observed. When first seen, the patient appeared toxic, had a temperature of 39.2 degrees C., and showed a reddened swelling just above the right internal malleolus. Five days after the onset of symptoms, roentgenograms of both legs, for comparison, showed two small areas of rarefaction in the lower end of the right tibia just above the epiphyseal line (Fig. 6). In this illustration a slight rarefaction of the medullary cavity in its distal inch also was detected.

At operation, a large subperiosteal abscess was found over the lower third of the tibia. The medullary cavity, which contained pus under pressure, was drained by a window 1 inch in length by ½ inch in width, a vaseline pack was inserted, and a cast was applied. The patient's temperature dropped to normal in a few days and he left the hospital after 10 days. Three months later, several sequestra were removed after which complete healing of the wound occurred.

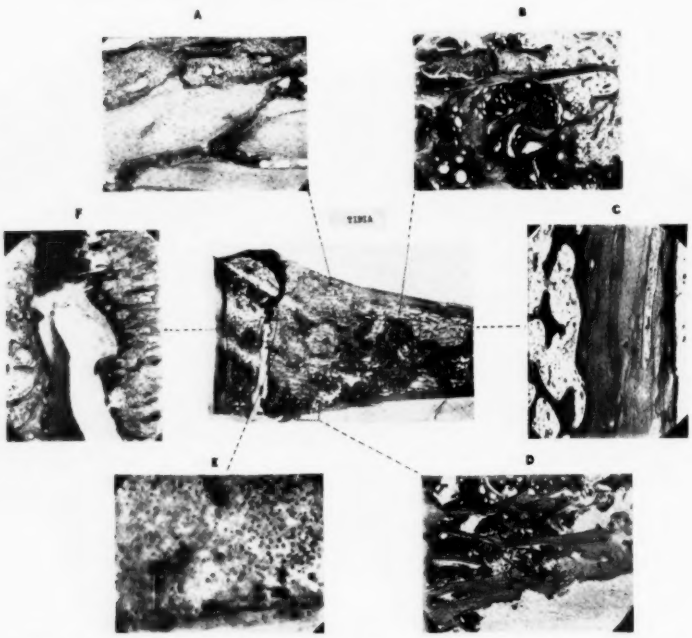


Fig. 5. Case 1. Photomicrographs of the distal end of the tibia, 8 days after the onset of symptoms. Peripheral photographs are enlarged views of the corresponding areas enclosed in dotted rectangles in the central photograph. *A*, Cortex crossed by enlarged haversian canal filled with pus; *B*, marrow at transition from infected to normal areas; *C*, normal cortex and marrow; *D*, thinned cortex, denuded of periosteum, and perforated in several places; *E*, clusters of staphylococci at origin of infection; *F*, epiphyseal line, undergoing solution.

Case 4. W. B., a boy 12 years of age, was seen 9 days after the onset of pain in the right ankle. One month earlier, two boils had appeared on the back of his neck and had healed. At entry, localized swelling, heat, redness, and tenderness were noted over the lateral aspect of the ankle, the temperature was 38.6 degrees C., and the white cell count 15,000. An X-ray picture taken 10 days after the onset of symptoms showed an osteolytic process involving both the cortex and medulla of the distal 2 inches of the right fibula, with a slight thickening of the overlying periosteum.

Operation at this time revealed an abscess which had lifted the periosteum from the anterolateral aspect of the lower fourth of the fibula. This extent of fibula was saucerized, the wound was packed with vaseline gauze, and a cast was applied. Healing occurred without the formation of sequestra. Microscopic examination of the fragments removed at operation showed dead spicules of bone surrounded by fibrous tissue which was infiltrated with pus cells, macrophages, and giant cells. The inflammation extended to the epiphyseal line of the fibula. A culture of the pus showed Staphylococcus aureus.

Case 5. T. S., a Japanese boy, 14 years of age, entered the hospital complaining of pain, swelling, and tenderness over the upper end of the left humerus of 2 days' duration. Eight days prior to entry, the patient had had a furuncle over the left knee. The white cell count on entry was 21,000 and the temperature was 38.8 degrees C. A blood culture showed Staphylococcus aureus. Roentgenograms of both shoulders were negative except for a slight swelling of the soft parts over the left shoulder.

An operation was performed within 2 hours of entry into the hospital and showed an abscess of reddish brown pus half surrounding the upper third of the left humerus on its anteromedial aspect. When a hole was drilled through the cortex a similar type of pus was found within the medullary cavity. A window 1.5 inches long and ½ inch wide was made through the cortex on the anteromedial surface of the humerus, extending to within 1 inch of the upper epiphyseal line. A vaseline pack was inserted loosely into this window and a spica cast was applied to immobilize the shoulder in abduction. The patient's temperature fell nearly to normal on the third day after operation, showed a secondary rise to 40.8

Fig. 6. Case 3. Roentgenograms of lower ends of both tibiæ, 5 days after onset of osteomyelitis of right tibia. There is an area of rarefaction just above the epiphyseal line, and decreased density of cancellous bone at the lower end of the right tibia.

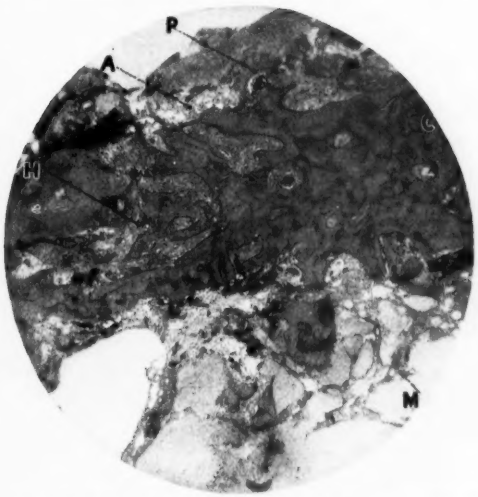


Fig. 7. Case 5. Photomicrograph of the upper end of the humerus, 2 days after the onset of osteomyelitis. Medium magnification. *P*, Periosteum stripped from cortex *C* by abscess *A*. *H*, Haversian canal through which infection passes outward from medullary cavity *M*.

degrees C. on the fifth day, gradually fell to normal on the tenth day, and showed no further rise above normal. Moderate drainage persisted until 3 months after the primary operation, at which time three sequestra were removed and the upper humerus was saucerized. After this the wound healed rapidly.

Microscopic sections of the window of bone removed at the primary operation 2 days after the onset of symptoms (Fig. 7) show an enlargement of haversian canals which provides pathways through the cortex along which the infection passes outward from the medullary cavity to the subperiosteal region. A small abscess is seen to be stripping the periosteum from the cortex. The large number of red blood cells seen in the exudate doubtless accounts for its reddish tinge noted at operation, and probably is a characteristic of the earliest stage of osteomyelitis.

CASE 6. A girl aged 13 months entered the hospital because of eczema involving the face and scalp. Ten days later, it was noticed that movements of the left shoulder were painful. The temperature rose to 40 degrees C. at this time, but gradually declined for 4 days. The temperature then rose again and there was moderate swelling in the region of the left shoulder. The X-ray examination of both shoulders, 8 days after the onset of symptoms, revealed a clear cut area of rarefaction in the upper end of the shaft of the left humerus extending up to, but not across, the epiphyseal line (Fig. 8).

An operation was performed on the following day, through an anterolateral incision. No periosteal thickening or abscess was encountered. A drill inserted through the cortex, encountered a cavity, and a thick purulent fluid flowed out of the drill hole. This cavity was exposed fully by the removal of a window of cortex 1 inch long and one-fourth inch wide. A vaseline pack was inserted but no cast was applied. The wound healed completely in 3 weeks, without the formation of sequestra. A culture from the pus encountered at operation gave a growth of Streptococcus hæmolyticus beta.

## REVIEW OF CASES

From a review of this series of six clinical cases, certain facts become evident. In all cases but 1, there was a history of infection of the skin or of a sore throat from 1 week to 1 month before the onset of the symptoms of osteomyelitis. Osteomyelitis usually begins in the shaft of a long bone, close to an epiphyseal line. The infection soon spreads outward through the haversian canals of the cortex to form a subperiosteal abscess. This abscess rapidly increases in size and lifts the periosteum from a large area of bone. Clinical signs of acute osteomyelitis become more obvious with the development of the subperiosteal abscess

Fig. 8. Case 6. Roentgenogram of the left humerus 8 days after the onset of osteomyelitis at its upper end. An abscess cavity is seen extending up to the epiphyseal line.

X-ray evidence of an osteomyelitic focus may be obtained as early as 5 days after the onset of symptoms, provided a roentgenogram of the normal extremity is taken for comparison. One should look for an area of rarefaction in the shaft close to the epiphyseal line. This is contrary to the usual teaching that the X-ray has no value in the diagnosis of acute osteomyelitis. On the other hand, one should not delay operation because the X-ray examination is negative.

A blood culture taken during the acute stage of osteomyelitis will be positive for Staphylococcus aureus in a large proportion of cases. In fact, the infection in the bone must result from the presence of such organisms in the blood. Blood cultures taken a few days after drainage of the osteomyelitic cavity usually are negative.

### TREATMENT

In acute osteomyelitis, widely varying operative procedures have been advocated, ranging from the opening of the periosteum only, in severe cases (Ochsner and Crile), to the radical excision of a large extent of the shaft (Le Conte). Starr drilled several holes through the cortex close to the epiphyseal line. It is Robertson's practice to follow this drilling with the removal of a small window of cortex to expose the abscess when one is found. A similar procedure is advocated by Bancroft on the basis of animal experimentation, as he concluded that cortex which is apparently dead may serve as the framework for a new shaft. Bancroft prefers postoperative dakinization of the wound.

A notable contribution to the treatment of osteomyelitis was made by Orr as a result of his experience in the World War. He secures adequate drainage by means of a window which completely exposes the infected portion of the medullary cavity, and the wound is held open by a vaseline pack. The application of a plaster cast immobilizes the limb in good position, thus resting the diseased part and preventing contamination of the wound. The entire dressing is changed with aseptic technique when the odor becomes marked or a rise in temperature occurs. The results obtained by the use of the foregoing method in the hands of many surgeons have proven to be very satisfactory.

### CONCLUSIONS

1. Osteomyelitis is an infection caused by Staphylococcus aureus which travels through the blood stream and localizes at the end of a long bone.

2. Early symptoms are pain, swelling, local heat, tenderness, a high fever, and a high white cell count.

3. Within 5 to 7 days of the onset of symptoms the X-ray may show a rarefaction of the cancellous bone near the epiphyseal line, which is apparent when compared with a film of the opposite side.

4. An operation should be performed as soon as a diagnosis of probable osteomyelitis is made and should consist of drainage of the medullary cavity by means of a window removed from the cortex. The use of a vaseline pack and cast, as advocated by Orr, has proved very satisfactory, although good results are obtained by Dakin's irrigations or by the use of other frequently changed dressings.

5. In some cases, a considerable portion of the shaft will separate as sequestra, and will be surrounded by newly formed bone (involucrum). The removal of sequestra should be attempted only when sufficient involucrum has formed to maintain the continuity of the bone, usually 2 or 3 months after the primary operation.

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# THE SINGLE PYOGENIC LIVER ABSCESS

## A Study of Twenty-Four Cases[1]

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This report is based upon the study of 24 cases of single pyogenic liver abscess which have come to operation since 1915. The purpose of this study is to emphasize the fact that the single pyogenic liver abscess is a definite, recognizable, clinical entity with a hopeful prognosis following surgical intervention.

### INCIDENCE

It is not possible to give an estimate as to how frequently this condition occurs since there are probably many liver abscesses which never come either to operation or to autopsy and the diagnosis is therefore often missed. Of our 24 cases, 17 were in males and 7 in females, or a ratio of 2.5 to 1. Pyogenic liver abscess is most commonly seen in young or middle aged adults; 8 of the 24 patients, or one-third the total number, were between the ages of 40 and 50 years. The youngest patient was 15 years old, the oldest was 65 years of age. Table I shows the age incidence.

TABLE I.—AGE INCIDENCE

| Age in years | Cases | Percentage |
|---|---|---|
| 1 to 10 | 0 | 00.0 |
| 10 to 20 | 1 | 4.1 |
| 20 to 30 | 3 | 12.5 |
| 30 to 40 | 5 | 21.0 |
| 40 to 50 | 8 | 33.3 |
| 50 to 60 | 6 | 25.0 |
| 60 to 70 | 1 | 4.1 |

### BACTERIOLOGY

Elsberg and Giordano found sterile pus in about 60 per cent of their cases. The pus from 11 of 24 cases in this group was sterile, a percentage of 45.8. Of the 13 cases in which organisms were found, 3 showed Staphylococcus aureus, 2 were Staphylococcus albus, 2 were streptococci, 2 were Bacillus mucosus capsulatus, 2 were unidentified gram positive bacilli, 1 was Bacillus coli, and 1 was Bacillus pyocyaneus. Eliason, in reporting 12 cases of liver abscess, also found the staphylococci, streptococci, Bacillus mucosus capsulatus, and Bacillus coli to be the invading organisms. Alessandri states that the principal organisms found are the staphylococci, streptococci, colon bacillus, typhoid bacillus, pneumococci, and Bacillus pyocyaneus. In this series there are no instances of two organisms being present in 1 case, but the 2 cases which showed gram positive bacilli may be examples of an anaerobic organism accompanying some other bacterial invader. No amœbæ or parasites were found either in the abscess cavities or in the stools of any of the cases.

Table II shows how frequently each organism was found and also the number of patients who recovered. It is striking to note that most of the deaths (8 of 10) occurred in those cases from which no organism could be found.

TABLE II.—INCIDENCE

| Organism | Cases | Recovered | Died |
|---|---|---|---|
| Sterile | 11 | 3 | 8 |
| Staphylococci | 5 | 4 | 1 |
| Streptococci | 2 | 1 | 1 |
| Bacillus mucosus capsulatus | 2 | 2 | 0 |
| Gram-positive bacilli | 2 | 2 | 0 |
| Bacillus coli | 1 | 1 | 0 |
| Bacillus pyocyaneus | 1 | 1 | 0 |

[1] The Surgical Services of Dr. William Linder and Dr. John Linder, The Jewish Hospital of Brooklyn.

TABLE III.—MULTIPLE LIVER ABSCESS

| Case | Etiological factor | Interval between original disease and liver abscess |
|---|---|---|
| Case 1 | Acute suppurative appendicitis | 5 weeks |
| Case 2 | Acute suppurative appendicitis | 2 weeks |
| Case 3 | Gangrenous cholecystitis | 15 weeks |
| Case 4 | Hæmorrhoidectomy | 4 weeks |
| Case 5 | Perforated duodenal abscess | ? |
| Case 6 | Acute empyema of gall bladder | 1 week |
| Case 7 | Acute suppurative appendicitis | 2 weeks |
| Case 8 | Gangrenous cholecystitis | 12 weeks |
| Case 9 | Gangrenous cholecystitis | 3 weeks |
| Case 10 | Pylephlebitis, origin unknown | ? |
| Case 11 | Chronic ulcerative colitis | 7 weeks |
| Case 12 | Hæmorrhoidectomy | 7 weeks |
| Case 13 | Portal vein thrombosis | ? |
| Case 14 | Etiology not determined | |

TABLE IV.—SINGLE LIVER ABSCESS

| Case | Possible etiological factor | Interval between original disease or possible etiological factor and liver abscess |
|---|---|---|
| Case 1 | Acute suppurative appendicitis | 26 weeks and |
| | La grippe | 9 weeks |
| Case 2 | Unknown | ? |
| Case 3 | Acute sinusitis | 3 weeks |
| Case 4 | Nasopharyngitis and la grippe | 4 weeks |
| Case 5 | Unknown | ? |
| Case 6 | Unknown | ? |
| Case 7 | Unknown | ? |
| Case 8 | Unknown | ? |
| Case 9 | Vague gastric symptoms | 20 years |
| Case 10 | Unknown | ? |
| Case 11 | Sciatica | 3 weeks |
| Case 12 | Unknown | ? |
| Case 13 | Follicular tonsillitis | 2 weeks |
| Case 14 | Unknown | ? |
| Case 15 | Nasopharyngitis | 4 weeks |
| Case 16 | Vague gastric symptoms | 4 years |
| Case 17 | Unknown | ? |
| Case 18 | La grippe | 1 week |
| Case 19 | Perforated peptic ulcer | 3 weeks |
| Case 20 | Unknown | ? |
| Case 21 | La grippe | 1 week |
| Case 22 | Acute cholecystitis | 23 weeks |
| Case 23 | Unknown | ? |
| Case 24 | Nasopharyngitis | 2 weeks |

Blood cultures were taken in 14 of the 24 cases and all proved to be negative. This is in keeping with results obtained by most investigators.

## PATHOGENESIS AND PATHOLOGY

The term "single" pyogenic liver abscess is perhaps not entirely accurate since the original pathological process frequently consists of many small abscesses, closely clustered in one area, which eventually conglomerate to form one large abscess, often multiloculated. According to Alessandri and others, the abscess occurs about five times more frequently in the right than in the left lobe and usually points to the dome of the liver. All the abscesses in this series were in the right lobe, 18 of them pointing to the dome. Four localized in the lower part of the right lobe, one was located in the middle anterior part of the right lobe, and one other was on the inferior surface. Concerning the reason for the great predominance of right over left lobe abscess, we refer the reader to the theories of Sérège, Dominici, and others.

There are thought to be at least six routes by which bacteria or emboli may reach the liver and thus give rise to abscess formation. These are by way of the portal vein, by way of the hepatic artery, through the bile ducts, by direct extension, by way of the hepatic veins, and through the lymph stream. Most authors think that infected emboli which are carried into the portal vein from foci of infection located in the appendix, stomach, duodenum, intestines, anal region, and pelvic organs, are the commonest cause of liver abscess. Eliason has expressed the belief that suppuration of the appendix is the cause of nearly 50 per cent of all liver abscesses. Bartle claims that the outstanding cause is thrombosis of the intrahepatic portal vein as a result of focal infection, or infection in the gastrointestinal viscera or pelvic and anal regions. Eliason also claims that when the hepatic artery is the portal of entry, the abscesses are small, multiple, and diffuse. Beaver states that abscesses formed by bacteria which are carried into the liver via the hepatic artery, are almost never found except when part of a general pyemic process. There is a rather general agreement in the literature that liver abscess as a result of infection through the lymph stream does not or rarely takes place. Reiniger and Kaufmann state that occasionally infected emboli from some focus in the head or neck will reach the liver by a process of retrograde embolism. The embolus arises from some vein in the head or neck and travels via the superior vena cava to the right auricle of the heart, then to the inferior vena cava, and finally to the liver by way of the hepatic veins. Some liver abscesses undoubtedly do occur by direct extension from external wounds penetrating into liver substance, and some are definitely the result of infection in the gall bladder with extension of the process through the bile ducts into the liver.

The foregoing writers rarely make distinction between the mode of origin and cause of multiple abscess of the liver, and so called single, or "primary" pyogenic liver abscess.

Scrutiny of the cases of single abscess in this series shows that the mode of origin or the etiological factor is known with a fair degree of certainty in only 3 of the 24 cases; whereas the etiological factor in a series of 14 cases of multiple liver abscess[1] (which came to autopsy or were operated upon) can be pointed out with certainty in 13 cases. Tables III and IV show the two groups, i.e., multiple abscess and single abscess, and their etiological factors.

It is seen in Table III that 3 cases of multiple abscess of the liver were preceded by acute suppurative appendicitis with appendectomy; 4 cases were preceded by acute cholecystitis with cholecystectomy; 2 cases were preceded by hæmorrhoidectomy. In one patient, a perforated duodenal abscess due to a foreign body was found at operation. One patient had chronic ulcerative colitis for 7 weeks preceding symptoms of liver abscess. Two patients showed definite portal vein thrombosis and infection at autopsy, but the origin of the thrombosis and infection was not determined. In 1 case no clue was given as to the etiology. It is clear that the portal of entry in 9 of the 14 cases of multiple abscess was through the portal vein, and in 4 cases by way of the bile ducts. In only 1 case was the mode of origin unknown.

Nine of the 24 patients with single liver abscess (Table IV) definitely gave a history of a preceding focal infection. Three of the 9 patients had a nasopharyngitis, 1 suffered from an acute sinusitis, and another had an acute tonsillitis, all within a period of 1 to 4 weeks before the onset of liver abscess symptoms. Three other patients gave a history of so called la grippe shortly before the onset of present illness, and another suffered from "sciatica" 13 weeks prior to onset of symptoms. It is important to state that no history of a focal infection or upper respiratory disease was obtained in any of the 14 cases of multiple liver abscess. In 11 cases of single abscess, no possible etiological factor could be determined. There were only 2 cases of single abscess in which the mode of origin was definitely known and in which the etiology could be unquestionably traced to portal vein or bile duct infection. In Case 19 (Table IV) patient had suffered from a perforated peptic ulcer 3 weeks preceding formation of the liver abscess, and in Case 22 (Table IV) cholecystectomy for acute cholecystitis had been performed 5 months previous to formation of the liver abscess. In Case 1 (Table IV) appendectomy had been done for acute suppurative appendicitis 6 months previously and patient had remained in good health following an uneventful recovery until 9 weeks before development of the liver abscess symptoms when he had been confined to bed with an attack of so called "la grippe." Two other patients (Cases 9 and 16, Table IV) had suffered from vague gastric symptoms for 4 years and 20 years preceding the onset of the present illness, but there was no history in either case of exacerbation of the gastric conditions at any recent date prior to the onset of the liver abscess syndrome.

From the foregoing analysis we see that 19 of the 24 cases of single abscess show no proof of infection by way of the portal vein or bile ducts. In 1 patient (Case 22) the infection arose through the bile ducts, and in one other (Case 19) or possibly two (Case 1) the infection arose through the portal vein. In the 2 cases with vague gastric symptoms the infection was of doubtful origin but the possibility of portal infection must be considered.

There is no reason to believe that the single liver abscess arises most frequently through portal vein or bile duct infection when proof of such a contention is entirely lacking in 19 of our 24 cases! To the contrary, it seems more likely that most of these single abscesses arose through hæmatogenous infection via the hepatic artery. This contention is strengthened by the fact that 9 of our 24 cases gave a definite history of a preceding focal infection.

Elsberg tended to support our view that the single abscess is infrequently of portal origin when he stated that single abscess is rare following appendicitis. Barr states that he has seen this type (single) of liver abscess occasionally follow septic sore throat, otitis media, osteomyelitis, and mastoiditis. Sussi reports a case of single pyogenic liver abscess following soon after a furuncle of the back of the neck. He was able to isolate the same organism (Staphylococcus albus) from the blood stream

[1] Unpublished data from Medical and Surgical Services of Jewish Hospital of Brooklyn.

and the liver abscess. His patient made an uneventful recovery following drainage of the abscess. Lepehne claims that infection may arise via the hepatic arteries due to suppurative processes in other internal viscera or in the skin. Beaver, however, is of the opinion that the organisms producing the single liver abscess gain access to the liver through the portal vein. In reporting 8 cases of granulomatous abscess of pyogenic origin, he admits that the etiological factor or origin is uncertain and questionable in 7, yet he comes to the conclusion that all arose through the portal vein. All of his cases came to autopsy, and although it was felt that the abscesses originated via the portal vein, pylephlebitis or portal vein thrombosis was found in only 1 case.

To summarize: The single liver abscess cases are most often of unknown or doubtful etiology, usually are without proof of portal vein origin, and infrequently show pylephlebitis or portal vein thrombosis. The multiple liver abscesses are of known etiology, arise through the portal vein or bile ducts, and usually show pylephlebitis or portal vein thrombosis.

The pathogenesis of the single pyogenic liver abscess strongly resembles that of carbuncle of the kidney and osteomyelitis. Focal infections such as a furuncle of the skin, sinusitis, otitis media, nasopharyngitis, and other upper respiratory conditions have long been designated as the source of hæmatogenous infection leading to the formation of osteomyelitis or carbuncle of the kidney. By the same token, the focal infections, present in the 9 cases of single liver abscess herein reported, might have been the sources of hæmatogenous infection leading to the development of the abscesses. The significance of a preceding focal infection can not be stressed too strongly!

### SYMPTOMS AND SIGNS

Most of our patients, on admission to the hospital, gave a history of having been sick for approximately 2 to 4 weeks, with fever and occasional chills. Loss of weight and strength within a very short time were almost constant complaints. At the onset, only a few of the patients suffered from abdominal pain or presented other symptoms referable to an intra-abdominal lesion. Despite the extreme malaise and asthenia which accompanied the early part of the syndrome, many of the patients spent some of the first few days of the illness out of bed, only to return when fever or chills recurred. Pain somewhere in the lower right thoracic region was frequently the first symptom to draw attention to the location of the pathological process. This symptom occurred usually within 1 to 3 weeks from the onset of the illness, although in about 20 per cent of our cases it was the first definite symptom of the entire syndrome. The indefinite nature of the patient's complaints, and the failure of localizing signs to appear, makes it extremely difficult to venture any diagnosis during the first week or two of the disease unless one is thoroughly acquainted with the symptom complex. Three patients had an onset resembling that seen in amœbic abscess. Of these 3 patients, 2 were sick for 3 months and 1 was sick for 6 months before admission to the hospital. Table V shows the duration of symptoms prior to hospitalization.

TABLE V.—DURATION OF SYMPTOMS PRIOR TO HOSPITALIZATION

| Cases | Duration of symptoms before admission |
|---|---|
| 3 | 1 week or less |
| 7 | 2 weeks |
| 6 | 3 weeks |
| 2 | 4 weeks |
| 1 | 5 weeks |
| 1 | 6 weeks |
| 2 | 3 months |
| 2 | 6 months |

Only 3 of the 24 patients were hospitalized within a week of the development of symptoms, thus leading to the conclusion that most of the patients originally gave the impression of not being in need of immediate surgical attention. Sixteen of the 24 patients were hospitalized within 3 weeks from the onset of symptoms.

Seventeen of the 24 patients definitely looked weak and toxic on admission and were listed as seriously sick. Only 2 patients appeared healthy. Malaise was almost constantly present. The majority of the patients had a muddy, subicteric complexion, which has often been referred to in the literature as being of hepatic origin. The scleræ in almost all cases were a muddy, tan color. Well developed jaundice was present in only 2 patients.

Both of the jaundiced patients had exceptionally large abscesses which extended well down on to the anterior surface of the liver and most probably produced pressure on the bile ducts. From the data in this series, it would seem that jaundice is infrequent and occurs only when the abscess exerts direct pressure on one of the larger bile radicals.

Fever was present in every one of the cases reported, and was invariably one of the first symptoms noticed. The average temperature range was from 99 or 100 degrees F. to 103 or 104 degrees F. and only occasionally rose to a higher level. The temperature was usually higher at the onset of the disease. Fourteen temperature charts showed the remittent type of fever and 10 showed the intermittent type. The pulse rate was in proportion to the temperature with the exception of a few cases in which there was a relatively slow pulse rate. The fever was accompanied by chills in 16, or two-thirds, of the cases, and 3 patients had definite chilly sensations with temperature rises. Sweating was found as a common occurrence after a chill. Periodicity of chills, or daily chills were infrequently seen in cases of single abscess but were quite commonly encountered in the patients with multiple abscesses.

Pain in the hepatic area was almost a constant complaint being absent in only 1 case. In 19 of 23 patients, or about 82 per cent, the pain was located anteriorly or laterally in the axillary line over some area from the level of the fifth rib down to the edge of the liver. Lumbar pain was present also in 3 of these 19 patients. In the 4 remaining cases the patients suffered only from lumbar or loin pain located over the hepatic region posteriorly. Localized intercostal pain, as Eliason, Alessandri, and others have pointed out, is often an important sign in liver abscess and should be looked for in every case in which the diagnosis is suspected. The pain in our cases was usually dull and aching in character, occasionally patients were encountered who had sharp, severe pain, and in several cases there was epigastric pain and distress prior to localization of the pain to the liver region. Dull pain was noted to be present more often than sharp pain. Seven patients suffered from epigastric pain but in 5 of these it was transitory and disappeared when localization occurred. The pain tended to be constant, without relationship to food intake, and without much tendency toward colic or marked changes in intensity. Nine of 23 patients, or 39 per cent, complained of aggravation of pain on inspiration. Many writers (5) report radiations of pain to the right scapular region, left scapular region, right lower quadrant of the abdomen, and to the neck. None of our patients complained of left scapular pain, of right lower quadrant pain, or of neck pain. Two patients did complain of right scapular pain and at operation one of them had an abscess which had ruptured into the subphrenic space, and in the other patient definite diaphragmatic involvement was evidenced on X-ray examination by fixation of the diaphragm and thickening of the diaphragmatic pleura. Since most of the abscesses come to the surface retroperitoneally on the dome of the liver, we see little reason why there should be radiation of pain, except when there is extension of the suppurative process to the peritoneum or pleura. The following outline summarizes our conception of the pain as it exists in liver abscess.

*Location*

1. Over liver area, anteriorly or in axillary line in 82 per cent of the cases.
2. Loin pain in 29 per cent of the cases.
3. Intercostal pain frequent.

*Type*

1. Usually constant.
2. No relation to food intake.
3. Dull pain more frequent than sharp pain.
4. Pain on inspiration in 39 per cent of the cases.

*Radiation*

Infrequent.

Tenderness over the liver area was found to a variable degree in all of the cases. If an enlarged liver was palpable below the costal margin, it was usually found to be quite tender. An important and significant finding was intercostal tenderness brought about by deep palpation with one finger. It was rarely necessary to use heavy percussion with the closed fist in order to elicit tenderness.

All but 2 of the patients complained of loss of appetite. Rapid loss of weight and strength were the usual observations. Nine of our 24 patients lost over 15 pounds in weight each, 6 patients lost between 5 and 15 pounds each, 3 patients thought they had lost some weight, and the 6 remaining patients did not know if there had been any weight loss.

Nausea and vomiting have not been found to be part of the liver abscess symptomatology. Only 3 of our patients complained of nausea and vomiting. This is particularly significant since there are so few conditions of a surgical nature in which one finds chills, fever, pain in the right upper quadrant of the abdomen, and other signs of a surgical lesion, and yet obtains no history of nausea or vomiting. The importance of the absence of nausea and vomiting as a helpful diagnostic lead, will be discussed later. Neither diarrhœa nor constipation occurred with any frequency. None of our cases gave history of prolonged diarrhœa.

As mentioned before, over one-third of the patients complained of pain on inspiration in the right lower chest and right hypochondrium. This is most likely due either to irritation or possibly to the added drag of an enlarged liver on the pleura. Mild shortness of breath and an increased respiratory rate were found in 12 of the 24 patients. This dyspnœa was mild, the respiratory rate ranging from 26 to 34 per minute, except for 2 cases who experienced marked difficulty in breathing. The marked dyspnœa in 1 case was probably caused by a large pleural effusion on the right side. Coughing was present in 14 cases and was usually hacking, non-productive in character. This is referred to by Alessandri as the "hepatic cough."

A very important clinical sign was an enlarged liver. The liver was palpable below the costal margin in 17 of 23, or in 74 per cent of the cases. In 8 of these 17 cases, enlargement of the liver in an upward direction was also elicited. Enlargement of the liver upward was found in 4 cases where no enlargement was palpable below the costal margin. Three cases presented fluctuant masses in the right upper abdominal quadrant. There were only 2 patients who demonstrated no hepatic enlargement!

Some degree of spasticity of the rectus muscle in the right upper quadrant was noted in about 60 per cent or in 13 of 22 patients. The spasticity, however, was rarely very marked and only approached real involuntary rigidity in a few cases. Abdominal examination for spasticity was negative in 9 of the 22 cases.

Street and Eliason refer to œdema of the right lateral chest wall as an important finding in liver abscess. We have not noted this sign in our cases. Manson-Bahr, in reporting 40 cases of amœbic liver abscess, found œdema of the chest wall in only 4 cases.

Pulmonary signs, located for the most part over the right lower chest, were seen in many of the cases. Limited expansion of the right chest was found in 7 patients, 11 patients had no limitation of expansion, and in the 6 remaining cases no statement as to this sign could be found in the histories. An enlarged and tender liver associated with diaphragmatic and pleuritic irritation most probably produced this limitation of motion. This contention is supported by the X-ray findings. X-ray and fluoroscopy were done in 5 of the 7 patients who had limitation of expansion of the chest, and in 4 out of these 5 patients a fixed and elevated diaphragm was found. Impaired resonance, dullness over the right lower chest was noted in 13 of 22, or approximately 60 per cent, of the cases. Many authors claim this to be due to compression of the right lung by the enlarged liver and raised diaphragm. Râles at the right base were a common finding, being present in 68 per cent of our cases. Five of our cases demonstrated pleural effusion in the right chest, but in only 1 case did it attain large enough proportions to necessitate aspiration. One patient developed an empyema of the right chest. The breath and voice sounds were recorded as vesicular in all cases, but occasionally were somewhat exaggerated or diminished. Signs of consolidation were absent in all cases.

Roentgenological and fluoroscopic examination was performed in 17 cases. Seven of the 17 examinations revealed elevation and fixation of the right side of the diaphragm, suggesting a "subdiaphragmatic lesion." The 10 other examinations were negative for any subdiaphragmatic lesion.

A palpably enlarged spleen was detected in only 2 cases. The enlargement of the spleen in these 2 cases may be explained by the fact that both of these patients were sick longer than 3 months before admission to the hospital.

No evidence of ascites was found in any of our patients.

Leucocytosis was found in all but one of our patients. The average number of white blood cells per cubic millimeter was 16,000; the average polymorphonuclear leucocyte percentage was 86. These averages seem to be quite typical of the individual counts in liver abscess cases as shown by the fact that 14 patients had a count somewhere between 12,000 and 18,000; and 16 patients had a polynucleosis between 80 and 86 per cent. The leucocytosis exceeded 20,000 white blood cells per cubic millimeter in only 5 cases and the polynucleosis reached 90 per cent in only 4 cases.

There were no characteristic findings in the urine. Bile was present in the urine of those patients who had definite jaundice.

### DIAGNOSIS

The diagnosis of single pyogenic liver abscess was made in the majority of our cases after a careful consideration of the general appearance, symptoms, and signs, and after close observation of the patient over a period of a few days. The difficulty experienced in making the correct diagnosis on first examination can be judged by the initial diagnoses made on the 24 cases in this series. Only 7 patients were admitted with the diagnosis of liver abscess. Six patients were thought to have lesions of the right kidney; in 3 of these the initial diagnosis was hæmatogenous infection of the right kidney, in 2 patients the diagnosis of perinephritic abscess was made, and the other patient was thought to have a pyelonephritis. Three patients were judged to have subphrenic collections of pus. The first impressions in the 8 other cases were: carcinoma of the stomach, duodenal ulcer with localized peritonitis, appendiceal abscess, cholecystitis, typhoid fever, tertiary syphilis, "acute abdomen" of unknown origin, and in one case no diagnosis was ventured on admission. It is interesting to note, however, that after several days of observation a final pre-operative diagnosis of liver abscess was arrived at in 16 of the 24, or in 66.6 per cent of the patients.

Most of our cases of single abscess were characterized by the lack of a significant antecedent history, although we feel that if a more careful search had been made in every case, many more histories might have included the presence of some previous focus of infection.

Fever, chills, and localized pain in the liver region associated with enlargement and tenderness of the liver, and slight or moderate spasticity of the right rectus muscle, constituted a syndrome which led to the diagnosis of an acute inflammatory lesion of the liver. The peculiar type of non-radiating, constant, dull, or occasionally sharp pain located intercostally or elsewhere directly over liver substance has seldom been seen by us in other conditions. An important aid to diagnosis is the absence of nausea and vomiting. With cholecystitis, pancreatitis, intestinal obstruction, ruptured ulcer, and other conditions accompanied by intraperitoneal irritation, one usually notes nausea and vomiting as a definite part of the syndrome, whereas in liver abscess, where there is usually very little peritoneal irritation, nausea and vomiting occur infrequently. X-ray findings of an elevated and fixed right diaphragm were found in approximately one-third of our cases and aided greatly in determining the location of the pathological process. The use of thorium dioxide sol in diagnosing liver abscess, as pointed out by Yater and Otell, Reeves and Apple, and others, has proved helpful to some investigators, but can not yet be tried as a routine procedure.

From a point of view of prognosis and treatment it is extremely important to make a differential diagnosis between single pyogenic liver abscess and multiple liver abscess, particularly since the former responds much better than the latter to surgical treatment. It has been our experience that this differentiation can best be made by study of the history, by noting the presence or absence of some definite source of infection, and by determining the route which the infective source traveled to reach the liver. If the patient gives a his-

tory of a previous infection such as cholecystitis, appendicitis, hæmorrhoids etc. (as in 13 of 14 of our cases of multiple abscess), then the infection reaches the liver via the portal vein or bile ducts and most probably results in multiple and diffuse abscesses. If, however, no history of a previous abdominal disease is obtained (as in 21 of 24 of our cases of single abscess), then one must suspect a single liver abscess and a hæmatogenous (via the hepatic artery) source of infection should be sought.

From examination of the patient, it was frequently impossible to distinguish single from multiple liver abscess. However, in the multiple abscess cases, we noted greater and more frequent fluctuations in temperature, many times from subnormal to 107 degrees F., along with daily chills. Jaundice was encountered more often in the cases of multiple abscess. Palpable enlargement of the liver and spasticity in the right upper quadrant of the abdomen were found in a greater percentage of the patients with multiple abscess than in those with single abscess.

The amœbic abscess is distinguishable from the pyogenic abscess by a history of a previous dysentery, by the presence of the Entamœba histolytica in the stool, and by differences in the two clinical pictures. The amœbic abscess characteristically has an insidious onset, over a period of many weeks, months, or years, which is usually devoid of very marked temperature rises or chills. Manson-Bahr found a history of dysentery or diarrhœa in 36 of 40 cases, and recovered the Entamœba histolytica from the stools of 57 per cent of these cases. Many patients with amœbic abscess are entirely free of symptoms, whereas pain and tenderness of the liver are almost always found in cases of pyogenic abscess.

The 3 cases in this series which were at first diagnosed as subphrenic abscess, all proved to have liver abscesses pointing to the right dome, all suffered pain on inspiration, and 2 of them were free of chills or chilly sensations. Pain caused by subphrenic abscess is usually more severe than in liver abscess, frequently radiates to the scapular region, and is almost invariably greatly aggravated by deep respirations. Chills are less frequently found in this condition and the temperature range is not as great. Jaundice is rare in uncomplicated subdiaphragmatic abscess. A history of a previous abdominal condition such as appendicitis, cholecystitis, perforated ulcer, and other intraperitoneal suppurative lesions is almost always obtained in cases of subphrenic abscess except when the purulent collection is due to a ruptured liver abscess. Such a history, as pointed out previously, was unusual in our patients with single liver abscess. The failure to find an enlarged and tender liver along with positive X-ray findings for a collection beneath the diaphragm, is often sufficient to allow differential diagnosis between subphrenic abscess and liver abscess.

Gall-bladder disease, since it is many times associated with fever, chills, pain, spasticity in the right upper quadrant of the abdomen, and jaundice, had to be ruled out. By securing a detailed history and by careful examination of the patient, a differential diagnosis was made. History of previous attacks of gall-bladder disease was of great moment since, as mentioned before, the single liver abscess was rarely preceded by cholecystitis. Furthermore, the rapid loss of weight and marked emaciation seen so often in liver abscess are unusual in cases of gall-bladder disease. Nausea, vomiting, pyrosis, belching, and aversion to fatty foods, which are typical prodromal symptoms in gall-bladder disease, were seldom encountered in our cases of liver abscess. The differences in the location and type of tenderness and pain in the two conditions are also invaluable to the establishment of the correct diagnosis. Liver abscess pain tended to be localized directly over liver substance, most often intercostally in the axilla or anteriorly, was constant in character, dull, or occasionally sharp, but rarely unbearable, and infrequently radiated. Pain caused by gall-bladder disease tends to be located over the region of the gall bladder anteriorly, is intermittent, colic-like, often excruciating and unbearable, and frequently radiates. Finally, in acute cholecystitis, which is the type most often confused with liver abscess, one can usually palpate an enlarged and tender gall bladder.

It can be seen from the initial diagnoses in our cases that difficulty was experienced in

differentiating liver abscess from suppurative lesions of the right kidney. This can be readily understood when one realizes that in 5 of the 6 cases in which the diagnosis was kidney disease the patients complained of loin pain, and in 3 of these 6, the loin pain was the only pain suffered. Furthermore, although there was liver enlargement in all of the 6 patients, the liver was readily palpable below the costal margin in only 3 patients. When the abscess involves the lower portion of the liver the condition is most likely to be confused with kidney disease, as evidenced by the fact that in 3 of the 6 cases the patients were later proved to have abscesses pointing to the lower part of the right lobe of the liver.

The onset of the liver abscess syndrome with chills, fever, pain in the right lower chest, occasionally accompanied by dyspnœa, cough and râles at the right base, sometimes leads to the initial diagnosis of an early pneumonia. However, the failure of additional pulmonary signs of consolidation to appear, along with the later development of an enlarged and tender liver, spasticity of the rectus muscle, and repetition of the chills, leads one away from this original impression.

Obscure cases may, on rare occasions, be diagnosed as gumma of the liver, typhoid fever, or malaria, but these diseases can usually be ruled out by such specific tests as the Wassermann and Widal reactions, or examination of the blood for the malarial parasite.

### TREATMENT AND RESULTS

The treatment of single pyogenic liver abscess is always surgical. The type of operation to be done depends upon signs of localization of the abscess. If a mass is found in the right upper quadrant of the abdomen or if it can be proved that an abscess is pointing on the anterior or inferior surfaces of the liver, it is wise to operate through a high right rectus incision. However, if there are no signs of localization of the abscess to the anterior abdominal region, then it is advisable to use a transpleural diaphragmatic approach, particularly since the great majority (18 of 24 cases in this series) of abscesses point to the dome of the liver. When there is doubt as to localization, it would seem best to explore through a transpleural diaphragmatic incision with rib resection because this procedure can be carried out retroperitoneally and thus reduce the chances of soiling the peritoneal cavity with the contents of the abscess.

Of the 24 cases, 12 patients were operated upon by the transpleural diaphragmatic two stage method. Sixteen of the 24 patients were operated upon by Linder, and of the 16, there were 10 operated upon by the transpleural method. The 6 other patients had right rectus incisions performed because it was felt that the abscesses were localizing either to the anterior or inferior surface of the liver.

There were 14 recoveries in this group of 24 patients, or a cure rate of 58.3 per cent. Eliason reports 54 per cent as the rate of cures in liver abscess. Linder, in operating upon 16 of the patients included in this report, had 10 recoveries, a 62.5 per cent cure rate.

The prognosis depends on many factors such as the general condition and resistance of the patient at the time of operation, the type and the virulence of the invading organism, the size of the abscess, the postoperative reaction, etc. Other things being equal, it would seem that the location of the abscess within the liver and the type of operation which can be performed, exert a very great influence on the ultimate outcome of the disease. Our results show that 12 of the 18 patients, or two-thirds of those with abscess localizing to the dome of the liver, recovered; whereas only 2 of 6, one-third, of those patients with abscess of the anterior or inferior surface, recovered. Also, 9 of the 12, or 75 per cent, of the patients operated upon by the transpleural diaphragmatic method recovered, whereas only 5 of the 12, or 41.7 per cent, of those operated upon through an abdominal approach survived (Table VI). It appears, therefore, that

TABLE VI.

| | Cases | Lived | Died | Per cent lived |
|---|---|---|---|---|
| Abscesses of dome of liver | 18 | 12 | 6 | 66.6 |
| Abscesses not of liver dome | 6 | 2 | 4 | 33.3 |
| Patients operated upon by transpleural route | 12 | 9 | 3 | 75.0 |
| Patients operated upon by abdominal route | 12 | 5 | 7 | 41.7 |
| Total cases | 24 | 14 | 10 | 58.3 |

the prognosis is better when the abscess localizes to the dome of the liver and when the approach can be made by the transpleural diaphragmatic route.

## SUMMARY AND CONCLUSIONS

1. Twenty four cases of single pyogenic liver abscess are reported.

2. The pathogenesis and symptomatology of single pyogenic liver abscess were discussed and a characteristic syndrome which can in most instances be differentiated from multiple abscesses of the liver and from other diseases was described.

3. Further investigation of the mode of origin of the single pyogenic liver abscess was urged in order to determine whether the abscess arises by infection through the portal vein or, as seems to be more probable, by hæmatogenous infection by way of the hepatic artery.

4. Diagnosis can be established in the majority of cases by careful evaluation of the definite and characteristic set of symptoms and signs.

5. Treatment of the single pyogenic liver abscess is surgical.

6. Recoveries were obtained in 58.3 per cent of all cases.

7. Abscess of the dome of the liver, approached by a transpleural diaphragmatic two stage procedure, gave a better prognosis than abscess elsewhere in the liver approached through an abdominal route.

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# THYROID CRISIS

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THYROID crisis is one of the unfortunate medical emergencies, and intensive treatment is often of no avail. The pre-operative use of iodine has reduced considerably the mortality of Graves' disease (exophthalmic goiter) and toxic adenoma (10, 12). It was thought by some that iodine would control even the most toxic patients (11). However, this idea is not entirely correct. Lahey stated that in a series of 1,118 patients treated for goiter in a year's time, the mortality rate from thyroid crisis equalled the post-operative death rate for patients with all types of goiter. The Greenes, in a more recent article, described the symptoms of thyroid crisis and emphasized some of the circumstances, even trivial in nature, which may precipitate the condition. They called attention to the interesting fact that occasionally a patient may develop crisis when a recent basal metabolism rate has been within the normal limits. Lahey stated that the mortality of thyroid crisis is high and fatalities may be prevented in some instances by the proper treatment.

In the following study all the available cases of goiter observed at the University Hospital (Ann Arbor, Michigan) since 1925 were reviewed. There were 123 patients who died as the result of this disease. Those who had serious complicating disease, such as diabetes mellitus, mitral stenosis, etc., were not included in this group. Seventy-two, or about 60 per cent of the 123 deaths followed operation on the thyroid gland. The 51 pre-operative deaths were considered to have been the result of a so called "thyroid storm" or "crisis" and were the object of the following study.

There were approximately twice as many females as males. The average age in each sex group was 50 years. The average first basal metabolism rate after admission was +49 per cent and the lowest was −2 per cent. Slightly more than half of these patients had either auricular fibrillation or signs of congestive heart failure or both. The remainder presented only subjective symptoms of cardiovascular failure, such as palpitation or shortness of breath, or both.

The patient with a basal metabolism of −2 per cent was of particular interest because of the rarity with which a pre-operative crisis develops under such circumstances.

She was 56 years of age and complained chiefly of weakness, shortness of breath, and palpitation. There had recently been a loss of 35 pounds of weight and the admission weight was 118 pounds. The thyroid was of the large nodular type. Lugol's solution had been administered for a 2 week period just prior to admission. The patient had auricular fibrillation and early signs of congestive heart failure (râles at the lung bases and slight œdema of the ankles). She remained fairly comfortable during the first 3 weeks at bed rest and received sedatives and digitalis in adequate amounts. The Lugol's solution was discontinued after admission. During an afternoon of the fourth week she cried constantly and complained repeatedly of a fear that her condition might become worse. That night she slept only a short time, and she did not sleep, except for brief intervals, through the following 5 days and nights, in spite of the administration of morphine sulphate 0.016 gram (H) on an average of every 7 hours during the restless period. Rather suddenly on the sixth restless day the pulse and temperature became abnormally elevated and during the succeeding 4 days they continued to rise. The latter finally reached 104 degrees F. and the former 150 per minute. Severe diarrhœa developed on the last day and the patient expired. No evidence of infection had been observed. The single basal metabolism rate had been taken during the first week in the hospital.

It is suggested that this case represents a so called "withdrawal crisis" brought on by discontinuing the Lugol's solution. Rest had been instituted to improve the cardiovascular status, and a second iodine remission was expected later, had it become necessary as a pre-operative preparation. It seems questionable that continuing the iodine medication would have done other than delay the final outcome. The situation might have been

TABLE I.—OPERATIONS THAT RESULTED IN THYROID CRISIS

| Case | Age | B.M.R. | Operation |
|---|---|---|---|
| 1 | 50 | +34 | Kraske |
| 2 | 44 | +22 | Hysterectomy and B-1. Salpingo-oophorectomy |
| 3 | 55 | ..... | Hysterectomy |
| 4 | 42 | +30 | Cholecystectomy and appendectomy |
| 5 | 54 | ..... | All teeth extracted |
| 6 | 59 | +27 | Two cystoscopic examinations |

much more favorable if Lugol's solution had not been given before admission to hospital.

For clarity, the 51 cases were subdivided into groups depending upon the precipitating factor or factors of crisis as far as it was possible to determine them.

*Cases admitted in crisis.* A fully developed thyroid crisis had developed in 8 of the 51 patients before admission to the hospital. These patients were either totally irrational or in coma. All were emaciated and dehydrated, and the majority died within 3 or 4 days after admission. The more elaborate diagnostic procedures were not done. The erroneous diagnosis of acute encephalitis had been made on one patient, and it was not until after necropsy that the true nature of the condition was realized. The findings regarding the presence or absence of acetone or diacetic acid in the urine were not recorded on any of these case records. None of the records of the urinary examinations, however, showed evidence of a glycosuria. Few patients will live who have reached such a marked state of toxicity.

*Crisis precipitated by surgical procedure.* Six of the 51 patients died as the result of a thyroid storm brought on by surgical procedure, the operations having been directed to correct disease of organs other than the thyroid gland. The operation in each case is charted (Table I). In no instance was the operation a surgical emergency.

This group illustrates the grave danger resulting from such operations. The mild clinical toxicity as was evidenced by the relatively low metabolism rates does not warrant such action, regardless of its minor character, unless it is thought a life-saving measure.

TABLE II.—INFECTIONS THAT PRODUCED THYROID CRISIS

| Case | Age | B.M.R. | Type of infection |
|---|---|---|---|
| 1 | 29 | +70 | Sore throat (hæmolytic streptococcus) |
| 2 | 41 | ..... | Sore throat (hæmolytic streptococcus) |
| 3 | 38 | +60 | Sore throat (Bacillus diphtheriæ) |
| 4 | 25 | ..... | Toothache |
| 5 | 32 | ..... | Acute cholecystitis |
| 6 | 38 | +61 | Abscess of the abdominal wall |
| 7 | 38 | ..... | Femoral thrombophlebitis with pulmonary infarcts |
| 8 | 59 | +27 | Chronic pyelitis (Same patient as Case 6, Table 1) |

*Crisis precipitated by infection.* As the result of crisis brought on by infection, 8 of the 51 patients died (Table II). This group, small as it is, shows a wide variety of infections and should serve to emphasize the importance of their development. It is generally conceded that this type of patient is more susceptible to infection than a normal person. The discomfort produced in these patients as a result of the infection appeared much greater than the nature or intensity of the infection would lead one to expect, and in all instances was not relieved even with opiate. It would appear to follow that under such circumstances there is an increased opiate tolerance.

*Crisis precipitated by therapeutic and minor diagnostic procedures.* In 9 of the 51 patients it appeared possible that crisis was precipitated by a therapeutic or diagnostic procedure (Table III). In all instances except those cited below these were preceded by an appreciable period of restful days and nights. The premonitory symptoms of crisis (nausea, anorexia, vomiting, diarrhœa, marked restlessness, great emotional instability, etc.) were of prompt onset and of short duration following the procedure. Total irrationalism, muttering delirium or coma accompanied by a rapidly rising pulse, temperature, and respiratory rate occurred within 24 to 48 hours. The 2 patients charted as having digitalis intoxication were the exceptions. By 1 of these patients (Case 4) 33 asymptomatic days had been spent at rest in bed. A mild sinus tachycardia had persisted. During the last 3 days the patient received 2.1 grams of the

TABLE III.—THERAPEUTIC AND DIAGNOSTIC PROCEDURES THAT WERE FOLLOWED WITHIN 24 TO 48 HOURS BY SEVERE CRISIS

| Case | Age | B.M.R. | Procedure |
|---|---|---|---|
| 1 | 50 | Unsatisfactory | Abdominal paracentesis |
| 2 | 53 | +63 | Thoracentesis |
| 3 | 45 | +47 | Spinal puncture |
| 4 | 48 | +10 | Digitalis intoxication |
| 5 | 48 | Unsatisfactory | Digitalis intoxication |
| 6 | 46 | +39 | B.M.R. determination |
| 7 | 49 | +51 | B.M.R. determination |
| 8 | 70 | +80 | B.M.R. determination |
| 9 | 44 | +74 | B.M.R. determination, electrocardiogram and chest X-ray (one day) |

equivalent of the powdered leaf of digitalis; 1.1 grams was the calculated theoretical dose. Shortly after the last dose had been given the patient vomited and the pulse rate rapidly increased to 132 per minute. Death occurred within a few hours. In the other patient (Case 5), there had been a recent fracture of the neck of the femur, initiating severe Graves' disease. Digitalis was given in an attempt to control the sinus tachycardia. At the time the patient had received 0.2 gram of the equivalent of the powdered leaf of digitalis in excess of the calculated theoretical dose, the heart rate increased from 110 to 180 per minute. The temperature and respirations remained about normal. In a further effort to control the tachycardia the drug was continued. By the end of a 14 day period the patient had received 6.7 grams of the equivalent of the powdered leaf—almost three times the theoretically calculated dose. An electrocardiogram at that time showed evidence of digitalis intoxication, rapid ventricular rate, and ventricular escape. The patient had not spent a restful night after the second day in the hospital and yet had received morphine sulphate 0.016 gram (H) on an average of every 7 hours as a supplement to routine sedatives.

Taken as a whole, the findings of this group would seem to point to a narrow margin of safety between restful improvement on the one hand and crisis on the other. It would also seem probable that even slightly aggravating procedures should be withheld whenever possible, even though the objectives are considered beneficial in the average patient. The highly toxic state would seem to contraindicate all diagnostic procedures which are not distinctly imperative for the patient's immediate welfare.

There were 125 procedures on the entire group of 51 patients which might have been delayed until a more favorable time. There were 22 successful first basal metabolism determinations and 12 unsuccessful first trials. To attempt a basal metabolism determination on a highly toxic thyroid patient is often of very little diagnostic value and at the same time may be an added risk to the patient's life.

*Patients in whom earlier or more intensive treatment may have averted crisis.* Nineteen of the 51 patients were classified in this group, making it the largest single division. There were 11 of these 19 patients in whom insomnia alone accounted for the more severe symptoms of crisis that finally developed. These 11 patients spent an average of 8 consecutive almost sleepless nights and days before the more severe symptoms appeared. For this restless period they received an average of 0.016 gram of morphine sulphate[1] (H) on an average of every 42 hours. Other sedatives (barbital, chloral, bromide, etc.) were routinely used but failed to induce sleep in these patients. The value of sleep could not have been appreciated sufficiently in some of these older cases.

Table IV shows the dosage of Lugol's solution as given to these 11 patients. When Lugol's solution was given it was administered on an average of 0.3 cubic centimeter three times a day. Had the drug been started when the premonitory symptoms of crisis appeared, each patient would have received an average of 10 cubic centimeters by the time of arrival of the more severe symptoms. It seems possible that the iodine medication was delayed too long to have been of much benefit to these patients.

Of the remaining 8 patients in this group, 6 developed diarrhœa accompanied by an average of 5 consecutive almost sleepless

[1]Morphine sulphate and pantopon were the only opiates used. When pantopon was used 0.02 gram was calculated as equivalent to 0.016 gram of morphine.

TABLE IV.—LUGOL'S SOLUTION AS ADMINISTERED TO ELEVEN PATIENTS

| Case | Age | B.M.R. | Lugol's solution (c.cm.) |
|---|---|---|---|
| 1 | 32 | ..... | 3.0 |
| 2 | 51 | +53 | 6.0 |
| 3 | 48 | Unsatisfactory | 0.3 |
| 4 | 46 | Unsatisfactory | 15.0 |
| 5 | 65 | Unsatisfactory | 0. |
| 6 | 63 | +51 | 6.0 |
| 7 | 55 | Unsatisfactory | 0 |
| 8 | 48 | ..... | 6.0 |
| 9 | 60 | Unsatisfactory | 0 |
| 10 | 70 | +80 | 5.0 |
| 11 | 65 | ..... | 0 |
| Average | | | 3.7+ c.cm. |

TABLE V.—LUGOL'S SOLUTION AS ADMINISTERED TO SIX PATIENTS

| Case | Age | B.M.R. | Lugol's solution (c.cm.) |
|---|---|---|---|
| 1 | 44 | +78 | 4.0 |
| 2 | 56 | +90 | 2.0 |
| 3 | 56 | +26 | 17.0 |
| 4 | 65 | +56 | 20.0 |
| 5 | 54 | +60 | 0 |
| 6 | 39 | +40 | 0 |
| Average | | +58 | 7.1 c.cm. |

nights and days before the more severe symptoms of crisis appeared. Lugol's solution, as given to these patients, is charted (Table V).

The 2 patients left in this group of 19 developed nausea and vomiting as early symptoms of crisis.

This group illustrates emphatically the imperative necessity of rest. Diarrhœa was finally controlled in every instance except 1 with either paregoric or tincture of opium. However, as a result of this symptom frequent bed changes were necessary and rest was disturbed.

In the group of 51 patients, excluding those admitted in crisis, there was a surprisingly large number of consecutive almost sleepless hours before the more severe symptoms of crisis. This figure gave approximately 128 such hours per patient for which each received an average dose of morphine sulphate 0.016 gram (H) on an average of every 41 hours.

### TREATMENT

*Recognition of impending crisis.* Sleepless nights, diarrhœa, anorexia, nausea, vomiting, marked sweating, and great emotional instability form an important group of early symptoms, and their occurrence in a toxic thyroid patient should arouse strong suspicion of impending crisis. They prevent rest and dehydrate the patient. With few exceptions, two consecutive sleepless nights were followed by uncontrolled restlessness until the more severe symptoms of crisis appeared. Usually there were warning symptoms of impending crisis. In 5 instances an increase in the average respiratory rate of at least 5 cycles per minute was the earliest discoverable indication. Weight loss should always be taken into account. The average weight loss in these 51 patients was 42 pounds in a time frequently less than several months before admission. It is an absolute necessity to estimate clinically the severity of the hyperthyroidism and the reserve power of the patient to withstand the strain. The wide variation in the metabolic rates on these patients would tend to reduce their importance in evaluating the toxicity and contribute nothing to an estimation of the patient's reserve. Every clinical feature must be taken into consideration; the duration of the disease, the weight loss, the admission weight, the age, the degree of circulatory failure, the pulse rate, the gastrointestinal status, the degree of dehydration, the amount of acidosis if present, the stability of the nervous system, the metabolism rate, the temperature, every complicating disease, especially infection, and finally, the amount of previous iodine medication.

Impending crisis can be treated with a fair degree of success. When the crisis has been fully established, however, the mortality will be high in spite of any type of treatment yet known. In this series of cases, infection was the only theoretically unavoidable precipitating factor and yet it played a rôle in only 15 per cent of the deaths. An alertness for the possibility of impending crisis, together with a keen regard for its premonitory symp-

toms and modes of precipitation, should avoid its development in the majority of cases.

MANAGEMENT

The highly toxic thyroid patient should be regarded as an emergency case. The patient should be placed immediately in a quiet room, unoccupied by another patient who may cause disturbances of any sort. A ward bed is out of the question. The routine history taking and examination should be restricted to a minimum. Diagnostic procedures that are not essential for the patient's immediate welfare should be delayed until a more favorable time. A special nurse is highly desirable when restlessness is difficult to control. These patients attempt to walk about, sometimes fall out of bed and become very nervous unless constant nursing care is provided.

*Sedatives and narcotics.* Absolute rest, especially at night, must be obtained if satisfactory results are to be expected. The most dangerous period appears to be the first week or ten days of hospitalization. New surroundings and anticipation of a major operation undoubtedly play a contributory part. There was a tendency to give insufficient doses of opiate to these patients as illustrated by the group under consideration in whom satisfactory rest was not obtained. Relatively large quantities of opiate are required to relieve the classical symptoms, and the dosage should be an amount sufficient to relieve these symptoms and obtain the much needed sleep. Hypnotics such as luminal, barbital, chloral, paraldehyde, and amytal[1] are of great value as a routine medication and frequently will control the restlessness without additional medication. When they fail to do so, however, one should not hesitate to supplement them with the opiates such as pantopon or morphine. A very restless patient may require pantopon 0.02 gram (H) as often as every 30 minutes for several doses before sleep is obtained. A dangerously low respiratory rate should be the only warning to stop such medication before the desired result is reached.

*Fluids.* It was impossible to estimate the average daily fluid intake of the 51 patients. However, a 3,000 cubic centimeter daily minimum should be maintained. If nausea or vomiting should diminish the intake by mouth, one should resort immediately to the subcutaneous or more preferably the intravenous route.

*Glucose.* These patients develop acidosis rapidly if the carbohydrate intake is curtailed (6). The carbohydrate reserves are diminished in all patients with toxic thyroid disease (15) and the high metabolic rate makes necessary the ingestion of abnormally increased amounts of carbohydrate to prevent acidosis. If acetone or diacetic acid is present in the urine there is urgent need of glucose. Glucose unquestionably provides an immediate available source of carbohydrate. Since the glucose storage in these patients is very likely to be impaired, it would seem more practical to give it slowly in the form of a 5 per cent solution, rather than by repeated injections of a hypertonic solution. This avoids transient hyperglycæmia with its resultant dehydrating action on the tissues, and the diuretic effect and unnecessary waste of glucose through the kidneys. That there is a rapid utilization of carbohydrate by patients with toxic thyroid disease has been determined by studies of the respiratory quotient (6). Therefore, it would seem unnecessary to give insulin, although it has been advised and used with no untoward effects.

*Iodine.* From a therapeutic viewpoint it is well to consider impending thyroid crisis a condition of impending dehydration and acidosis, and to depend upon the administration of iodine alone, even for a short time, is a serious mistake. If iodine is to be used it should be started when the premonitory symptoms of crisis appear.

In the majority of patients with Graves' disease (exophthalmic goiter) the administration of iodine will result in a remission of toxic symptoms provided it has not been given previously (10, 12). With these patients the incidence of remission is not as high and the remissions are not as striking in goiter areas as elsewhere (4). This is probably due to the popular use of iodine in many forms in goiter areas (13). It has been reported that almost half of the patients with so called toxic

[1]This drug has been found very effective when given intravenously.

adenoma will show a moderately favorable response to iodine medication if not made refractory by previous iodine drugging (4). Iodine, therefore, is essential in the treatment of impending thyroid crisis as well as in the pre-operative preparation of these patients. Its indiscriminate use is not wise in patients who might remain too toxic for safe operation at the end of the period of expected iodine remission, unless the danger of impending crisis compels its use. Occasionally this becomes a fine point of judgment. The vast majority of these patients will improve on bed rest, sedative drugs, and a favorable environment. In patients who do not seem in danger of impending crisis, but who are too toxic for reasonable surgical risk, it would seem wise to withhold iodine for a period of days, weeks, or even months and thus reserve the iodine remission for an immediate pre-operative preparation at a more favorable time. In patients who can take iodine by mouth, Lugol's solution may be given in 1 cubic centimeter doses daily. If there is nausea or vomiting, Lugol's solution may be given intravenously, well diluted with the fluids, in doses of 2 cubic centimeters daily.

Iodine would play a much more important part in the treatment of toxic thyroid patients if so many were not made either partially or totally refractory to the drug by previous attempts at cure with its use. It is the general opinion of the medical staff at this hospital that the toxic thyroid patients who have *not* received iodine before admission to the hospital for operation are still relatively few in spite of the common knowledge that all iodine remissions are of temporary character. The failure of an iodine remission to take place in face of an impending thyroid crisis may cost the patient's life. Preliminary iodine drugging during the few weeks just prior to admission to the hospital for operation is not advocated. Indiscriminate iodine administration to patients immediately on admission to the hospital for operation appears unjustified.

*Digitalis.* In no instance in the series of 51 patients was full theoretical digitalization or overdigitalization followed by a decrease in the pulse rate. In 4 patients incomplete theoretical digitalization was followed by an appreciable decrease in the pulse rate. However, this last observation was confused by rest in bed. It may be concluded by such findings that full digitalization of highly toxic patients is not likely to be attended with an appreciable slowing of the pulse rate. Digitalis should be given, however, to all toxic thyroid patients who have auricular fibrillation, since in a great majority of such patients a beneficial effect will occur. Barker et al found an average decrease in the pulse rate of 29 beats per minute in a group of 108 toxic thyroid patients with auricular fibrillation. From the observations on 2 cases, reported in this paper, overdigitalization appeared extremely harmful. In rare instances the toxic thyroid patient will be found intolerant of the average amount of digitalis and a thyroid crisis may be precipitated (16). Usually toxic thyroid patients have an increased tolerance to digitalis in the neighborhood of 134 per cent (3). Digitalis should be given to all toxic thyroid patients who have or have not auricular fibrillation and who have definite cardiac enlargement or signs of congestive heart failure, since these patients are very likely to have a complicating factor of cardiovascular disease, either hypertension or arteriosclerosis, more rarely rheumatism or syphilis (2, 14). Full pre-operative digitalization of patients in this particular group who do not have auricular fibrillation may prevent an unnecessary period of cardiac strain should fibrillation develop during or shortly after operation, as is frequently the case.

The conversion of auricular fibrillation to normal rhythm by the use of quinidine sulphate is best reserved as a postoperative measure (1, 3).

This statement is frequently disputed on the grounds that there is a lower mortality rate in patients who go to operation with a normal rhythm than in those who attend operation with auricular fibrillation. It should be remembered that the abnormal rhythm is but a single evidence of a generalized toxicity and that its alteration does not affect the patient's general condition. There is slight mechanical advantage of the efficiency of the normal rhythm over that of auricular fibrillation controlled with digitalis, but this advan-

tage must be balanced against the dangers of quinidine therapy in the more toxic patient, against the chance of false security on the part of the surgeon, against the probable return of the auricular fibrillation during or shortly after operation and, finally, against the trouble of reconversion with further quinidine should such be necessary.

There has been little emphasis placed on thyroid crisis in the current literature. Lahey has repeatedly called attention to the importance of this condition. Co-operation from all sides together with a better understanding of these highly toxic patients is needed, if the pre-operative mortality is to be reduced to a minimum.

Thanks are given to Dr. Cyrus C. Sturgis and Dr. Henry Field, Jr., for their invaluable assistance.

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# THE PRESENT STATUS OF BLOOD EXAMINATION IN THE DIAGNOSIS OF SURGICAL INFECTIONS

## With a Study of Twenty-seven Indices of Infection Reported in the Literature

HENRY N. HARKINS, M.D., Ph.D., Chicago
From the Service of Dr. Edmund Andrews, Department of Surgery, The University of Chicago

WITHIN recent years there has arisen a tendency to distrust the value of total and differential blood counts in the diagnosis of surgical infections. In many instances this lack of trust is well founded, as cases of overwhelming peritonitis with normal total counts are only too common, as are cases of severe sepsis with polymorphonuclear leucocyte percentages varying all the way from zero to one hundred. Because of this lack of certainty in the interpretation of the conventional counts, variations have been devised, so many in fact, that in the present article the writer reviews twenty-seven such methods.

When the surgeon is confronted with such a multitude of methods he is apt to abandon all of them. Furthermore, and quite important, many of these methods were devised by hæmatologists who are not surgeons and the methods were not originally intended for the diagnosis of surgical infections. The surgical infections are somewhat peculiar to themselves and only certain hæmatological procedures are most suitably applied to them. It is the purpose of this paper to analyze the various methods of blood examination and determine which are most applicable to the diagnosis of surgical infections. By the term surgical infection is meant septic processes such as acute appendicitis, acute peritonitis, septic arthritis, pyogenic abscesses and similar conditions. The diagnosis of these infections is of prime importance for they are by definition conditions in which surgical treatment is indicated.

### CLASSIFICATION

It is possible to classify the methods as follows:

1. The total leucocyte count.
2. The conventional differential count.
3. Various indices of proportion between the total leucocyte count and the differential count.
4. Methods that take the nuclear changes in the polymorphonuclear neutrophiles into consideration.
   (a) Arneth's "shift to the left" and its modifications.
   (b) The Schilling hæmogram and its modifications.
5. Cytoplasmic toxic granulations.
6. Sedimentation rate of the erythrocytes.
7. Miscellaneous reactions.

### I. THE TOTAL LEUCOCYTE COUNT

From the time of the first total leucocyte count by Malassez in 1872, the variations in the count have been studied in all sorts of conditions. Sadler, in 1892, noted the increase of leucocytes in infections and Cabot, in 1894, in a study based on 332 blood counts discussed the leucocytosis of appendicitis, peritonitis, and other infections. Smith (1913) and others have propounded the view that a high leucocyte count is a bad sign, but many exceptions to this rule have been observed. Koritschoner (1927), in comparing the total leucocyte count with the pathological report in 170 operated upon appendices found 4 of 57 acute cases below 10,000 and 29 of 96 chronic cases above 10,000. He believes the high count in the chronic cases is due to the elements of fear and the stress of admission to the hospital. In no condition does the total leucocyte count so misrepresent the actual state of affairs as in septic granulopenia which has been shown by the writer (1931–1932) and by others. Piney (1926) states that the size of a leucocytosis is not of prime importance just as the size of a tumor can give little information as to its nature.

The total leucocyte count is known to vary extensively under normal conditions. Goldscheider and Jacob (1894) first discussed distribution leucocytoses. Sabin, Cunningham, Doan and Kindwall (1925) find an approximately hourly rhythm of the leucocytes, all cells not being affected alike. Arneth and Ostendorf (1923) say the average rise in the total leucocytes in digestion leucocytosis is 35 per cent, the rise affecting the polymorphonuclear leucocytes to the greatest extent and the Arneth shift very little. Garrey and Butler (1929) deny the presence of a digestive leucocytosis, but show that running a quarter of a mile will raise the total leucocyte count to 35,000 in a normal individual and that pain may raise it to 20,000 in a subject resting in bed and be mistaken for infection. Shaw (1927) advances the view that the leucocytes of man exhibit twice daily a tidal rhythm of about 12 hours' duration which is independent of certain recognized physiological stimuli. From these results in normal persons, it is seen that the total leucocyte count may often be misleading in surgical infections. Furthermore, the use of a series of hourly counts in determining the indication for operation in doubtful cases of appendicitis may merely record physiological changes rather than the progress of the infection.

2. THE CONVENTIONAL DIFFERENTIAL COUNTS

It is generally recognized that in the pyogenic infections the percentage of polymorphonuclears increases. However, as has been pointed out by the writer and others, in septic granulopenia the polymorphonuclear percentage falls to zero. Furthermore, Boies (1931) states that this percentage can vary from 56 to 78 per cent in an hour. Despite these obvious objections to the use of the conventional Ehrlich differential in the diagnosis of surgical infections, the changes of several of the constituent cells are of importance including the eosinophiles, lymphocytes, monocytes, and the macropolycyte. These are briefly considered in the following paragraphs.

*Eosinophiles.* The increase of eosinophiles in allergic conditions and parasitic infections is a well known phenomenon, but the aneosinophilia of acute pyogenic infections is a less well known although no less definite occurrence. Page, Turner, and Wilson (1928) discuss eosinophilia in 5,500 medical cases, while Jones and Crocker (1927), Baum (1929), Schilling (1929) and Allen (1930) have noted the aneosinophilia of acute surgical infections and the reappearance of eosinophiles during recovery. Allen states that a basophilia indicates loss of resistance. Sours (1932) has observed in appendicitis "that if an aneosinophilia persists past the sixth postoperative day, the infection usually overcomes the patient."

*Lymphocytes and monocytes and the lymphocyte/monocyte ratio.* The diagnostic value of these cells is presented first in the dictum advanced by Schilling (1924, 1932) that every pyogenic infection has three phases, the polymorphonuclear leucocyte defense stage, the monocyte stage of recovery, and the lymphocyte stage of cure; and, secondly, is shown also by the lymphocyte/monocyte ratio. Sours says that in an ordinary case of appendicitis going on to recovery, the monocytic response starts about the third day and reaches its height about the seventh day. The lymphocytic phase occurs about the seventh to the tenth day. In general it appears that while the lymphocyte/monocyte ratio may be of value in tuberculous and other chronic infections it is of only secondary importance in the diagnosis of surgical infections.

*The macropolycyte.* This cell, while not included in the original Ehrlich differential is considered to be of much diagnostic import by Cooke and Ponder. These authors (1927) state: "The macropolycyte . . . . is of grave prognostic import, and in our experience no patient has lived beyond a few days from its appearance in the peripheral blood." The writer believes that the megacaryocytic type of macropolycyte appears too irregularly in the blood stream to be used in the diagnosis of surgical infections, but when considered in conjunction with other blood changes may be of some value in prognosis.

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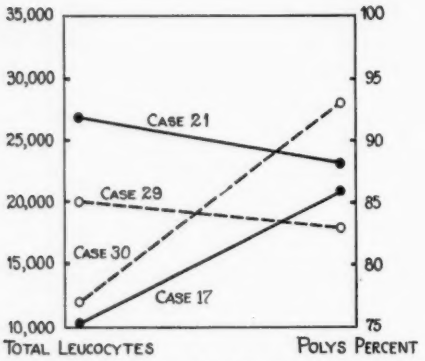


Fig. 1. The Gibson standard chart. An ascending line is supposed to indicate a poor prognosis and a descending line a good prognosis. The four lines in the above graph represent four cases studied by the writer. The two solid lines are from blood counts taken just before operation in two non-fatal cases of appendicitis. The two broken lines are from blood counts taken the day of death in 2 cases of pelvic peritonitis. These 4 illustrative cases indicate the fallibility of the Gibson chart in diagnosis and prognosis.

frequently given misleading information that a correlation of the two was suggested. Sondern (1905) stated that he had observed in personal work with 5,000 blood examinations: "In all cases of which I have a clinical record, no pus or gangrene was ever observed with a polynuclear percentage below 70 . . . Eighty-five per cent or over of polynuclear cells I have never seen without a purulent exudate or gangrenous process irrespective of the leucocytic count" and only one case over 94.5 per cent did not end fatally. Septic granulopenia is an obvious exception to the first of these two rules of Sondern.

*The Gibson standard chart.* Gibson in 1906 interpreted this postulate in graphic form as is seen in Figure 1. Gibson considered the normal total leucocyte count to be 10,000 or less and the normal percentage of polymorphonuclears to be 75 per cent. For every rise of 5 per cent in the latter, there should be a corresponding rise of 5,000 in the former. If this rise in the total leucocyte count does not occur the line rises and the prognosis is bad; if the line descends the prognosis is good. Menninger and Heim give an extensive literature on the Gibson standard chart and find a fairly good correlation with the findings in their 309 cases of appendicitis as do Neal and Robnett in their 227 cases of appendicitis.

*Walker's index of resistance.* Walker in 1919 devised his index of resistance (IR),

$$IR = (T-10)-(P-70) = T-P+60.$$

where $T$ equals the thousands of total leucocytes and $P$ equals the percentage of polymorphonuclears. Walker used this index in 105 cases. A positive index is a good omen, but often there is a positive antemortem index. Middleton and Gibbon (1930) modify Walker's index by using seventy-five instead of seventy in the equation.

*The lymphocyctic index.* Jones and Crocker (1927) use a lymphocytic index computed like Gibson's. McDonald (1931) represented this index by the equation

$$IR = (T-10)-(20-L) = T+L-30.$$

where $T$ equals the thousands of total leucocytes and $L$ equals the percent of lymphocytes.

Watters (1913) charts the leucocyte count by a solid line and the polymorphonuclear percentage by a broken line on Gibson's chart. The solid line should remain above the broken one.

*Absolute values.* Alsolute values for the counts of the different cells found in the differential have been advocated by Boerner (1930), Middleton and Gibbon (1930), and Kolmer (1931). Reznikoff states that absolute values are of much less value than the percentage determinations because of the great variation of the total count in different phases of pathological conditions.

### NUCLEAR CHANGES IN POLYMORPHONUCLEAR NEUTROPHILES

4a. *Arneth's "shift to the left" and its modifications.* When it was noticed that the total leucocyte count and the differential count alone and in many instances a combination of the two did not give true information as to the presence of an infection, hæmatologists sought other methods. Arneth (1904) working at the Leube clinic was one of the pioneers in this field, basing his observations on the age of the polymorphonuclears. Several observers had previously noticed the correlation between nuclear immaturity and infection. Muir (1891) states: "Also, when there is leucocytosis, especially if acute, there are

found more intermediate forms between the two varieties (polymorphonuclears and lymphocytes), and there are proportionately fewer corpuscles in which the nuclei are quite separate from one another, i.e., in suppuration etc., a greater number of the corpuscles appear to be of younger age or more recent formation." Ewing (1901) finds many myelocytes with the polymorphonuclear leucocytosis of infectious diseases. It remained for Arneth to analyze minutely these changes. He divided the polymorphonuclear neutrophiles into five classes depending on whether the nuclei have one to five lobes. These classes were divided into subclasses so that in all 21 individual types of polymorphonuclear neutrophiles were counted. The normal figures for the different classes in one hundred polymorphonuclear neutrophiles are

| Class | I | II | III | IV | V |
|---|---|---|---|---|---|
| Number of cells | 5 | 35 | 41 | 17 | 2 |

Since this was always charted in this form, an increase of the cells of type I is a shift to the left and an increase of the multinucleated cells of Class V is a shift to the right. A shift to the left occurs in infections and a shift to the right in pernicious anæmia.

The chief objection to the Arneth count is its complexity. This makes it more readily applicable to chronic conditions as tuberculosis where the expenditure of much time is not a handicap. In the rapidly changing events of a busy surgical service, a lengthy procedure as the Arneth count finds little place. Furthermore, as will be shown later, most of Arneth's subdivisions of the polymorphonuclear neutrophiles are in the more mature cells which are affected by such slight changes that their alteration is of little value in the more severe type of surgical infection.

*The polynuclear count.* The polynuclear count of Cooke and Ponder (1927) is one of the most popular of these simplifications. These authors neglect the subclasses and consider only the five main classes. The normal values of the polynuclear count are not quite the same as for Arneth's five classes.

*Needles neutrophilic graph.* Needles (1932) introduced a graph wherein he charts the normal line of Cooke and Ponder's five classes, then using a point between the second and third classes as a fulcrum, obtains clockwise (left according to the old classification) and counterclockwise (right) shifts.

*Counting the nuclear lobes.* Von Bonsdorff (1913) devised the method of counting the nuclear lobes in one hundred polymorphonuclear neutrophiles. Von Bonsdorff found the normal value to be around 280 in men and slightly less in women.

*The weighted mean.* This term was devised by Cooke and Ponder to designate the mean number of nuclear lobes per polymorphonuclear neutrophile. This is equal to the number of nuclear lobes divided by the number of cells and should be above 2.4 in normal individuals. Piney (1929) finds the weighted mean in health varies from 2.47 to 3.11 with an average of 2.74.

*The Bushnell and Treuholz index.* These authors (1908) add the number of cells in Arneth's Classes I and II and half of those in Class III. The normal average index by this method is 67.

*The Henson index.* Henson (1914) states that the normal summation of Arneth's Classes I and II is forty cells. He uses as his index the excess of this summation over normal. Thus fifty cells would be a +10 index and indicative of infection.

4b. *The Schilling haemogram amd its modifications.* Schilling simplified Arneth's count by dividing the polymorphonuclear neutrophiles into four classes: myelocytes, young forms, staff forms, and segmented or adult forms. Since he combines small and large lymphocytes into one group and both of Ehrlich's types of monocytes into one group and since Ehrlich had already given myelocytes a separate grouping, Schilling's eight types of cells as shown in Table I are no more in number than the conventional Ehrlich count. As will be shown later, Schilling's contribution is that his subdivisions are those that are of most practical value. Weiss (1931) says in this connection that "the actual significance of the percentage of neutrophiles lies in one of its component parts, the percentage of staff or immature neutrophiles. Once this is understood all of the apparent discrepancies can be solved." The differentiation between segmented and non-segmented polymorphonu-

clears is of prime importance in the diagnosis of surgical infections, while the subdivision of lymphocytes into small and large varieties is of little practical value except in one disease, lymphatic leukæmia.

The writer puts the upper limits of normal of the total leucocyte count and the staff percentage higher than does Schilling.

TABLE I. THE SCHILLING HÆMOGRAM

| | | | | Neutrophiles | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | WBC | E | B | My | J | S | A | L | M |
| Normal ranges | 5,000<br>11,000 | 2<br>4 | 0<br>1 | 0<br>0 | 0<br>1 | 3<br>10 | 51<br>67 | 21<br>35 | 4<br>8 |
| Normal average | 8,000 | 2.5 | 0.5 | 0 | 0 | 5 | 63 | 23 | 6 |

WBC = total leucocyte count
E = eosinophiles
B = basophiles
My = myelocytes
J = juveniles
S = staff cells
A = adult polymorphonuclear neutrophiles
L = lymphocytes
Mo = monocytes

In surgery the Schilling hæmogram seems to be peculiarly adaptable. It has been used by Allen (1930), Lippincott (1930), Thompson (1930), Miller (1932), and Kilbury (1932). Kolmer (1931) says "I strongly advise surgeons to adopt this shift to the left and nuclear index method for routine differential leucocyte counts and reports." Connor (1931) in discussing blood pathology in relation to surgery says "the Schilling hæmogram bids fair to become a valuable procedure in diagnosis and prognosis." Goodale and Manning (1931) compare the hæmogram with the microscopic findings in a series of 40 operated upon appendices and finds the agreement very good. Yaguda (1931) in a study of 671 pathologically examined appendices finds the hæmogram much superior to Gibson's line and concludes: "In the presence of a normal immature count, I agree with Cooke that an inflammatory process in the appendix can be definitely excluded."

Reznikoff (1929) points out that the total count lags behind the hæmogram findings. Furthermore in 30 fatal pneumonias 57 per cent had a total leucocyte count below 10,000, but all had more than 10 per cent non-segmented polymorphonuclear neutrophiles. Yaguda says that physiological leucocytoses do not affect the percentage of non-segmented cells. Schilling (1924) shows that there is some daily variation in this percentage in normal individuals, but that it is not so marked as the variation in the total leucocyte count or the percentage of polymorphonuclears. Harter and Lyons (1933) state that moderate exercise and emotion give neutrophilia without shift, but that a severe stress gives also a shift. Doan and Zerfas (1927) in discussing the rhythmic range of the white blood cells show that the shift to the left does not vary as much as the total counts. Baum (1929) believes in serial hæmograms which are taken at regular intervals.

*Pons and Krumbhaar's classification.* Pons and Krumbhaar (1924) attempted to simplify Schilling's hæmogram by using only three classes.

Class I = metamyelocytes
Class II = staff cells
Class III = segmented cells

However, since these authors also counted the myelocytes separately, in reality they have as many subdivisions of the polymorphonuclear neutrophiles as Schilling.

*Non-filament counts.* The most extreme simplification of the original Arneth scheme is to divide all polymorphonuclear neutrophiles into filamented (segmented) and non-filamented (non-segmented) forms. Even this simple procedure was attended with much argument. There was debate concerning the names given these two groups and concerning whether to consider the percentage of non-filamented forms as that of one hundred leucocytes or one hundred polymorphonuclears. Kothe (1908) used the percentage of "mononucleated" polymorphonuclears in one hundred leucocytes. Schilling (1929) speaking of the percentage of non-filaments in one hundred leucocytes as opposed to the use of the complete hæmogram says the non-filament percentage "is of interest only within the narrow limits of one disease (appendicitis)" and gives a classification:

| Per cent | Degree shift |
|---|---|
| 11–25 non-filaments | = 1st |
| 25–45 non-filaments | = 2nd |
| 45–60 non-filaments | = 3rd |
| more than 60 non-filaments | = 4th |

*Nuclear index.* Gerard and Boerner (1930) and Boerner (1932) present a method of expressing the non-filament count. The nuclear

index of these authors should be over fifteen in normal persons (average 36.6), whereas children younger than 1 year of age average 2.81. The nuclear index (NI) is calculated on the basis of one hundred leucocytes and expressed as:

$$NI = \frac{\text{Filamented polys}}{\text{Non-filamented polys}}$$

15–17 = normal
10–15 = slight shift
5–10 = moderate shift
0– 5 = severe shift

*The Schwarzbart chart.* Schwarzbart (1931) has represented all the elements of the hæmogram in a very graphic way. He has vertical scales for each cell type running from left to right. These scales are so adjusted that an equal vertical change in one cell type corresponds to an equal vertical change in another. A heavy line across the center of the chart represents the normal average and lighter lines above and below, the normal ranges of each type of cell.

### 5. CYTOPLASMIC TOXIC GRANULATIONS

Cytoplasmic criteria of the age of leucocytes in normal individuals are extensively used by hæmatologists. The evidences of immaturity include mitachondria and amœboid activity in supravital preparations, cytoplasmic basophilia and the presence of centrosomes and the Golgi apparatus. Fitzhugh (1932) believes that the best criterion of immaturity is the presence of cytoplasmic granulations. Young neutrophiles have more basic staining granules scattered in with the neutrophilic granules than do mature forms. In the latter, the specific granulation is amphophilic or slightly acidophilic in character.

Kugel and Rosenthal have devised a degenerative index:

$$\text{Degenerative Index} = \frac{\text{Degenerated polymorphonuclears}}{\text{Total polymorphonuclears}}$$

and state that "the persistence of a degenerative index between 90 and 100 per cent is of grave prognostic import and usually followed by death."

Prochnow (1931) analyzes several cases of appendicitis with simultaneous Schilling and pathological granulation charts and finds the hæmogram much better. In pneumonia the peak of the pathological granulation curve appears after the crisis. In conclusion Prochnow states "*Laesst sich wohl feststellen, dass die Hæmogrammethode in der Diagnose und Prognose der akuten Appendicitiden ein viel empfindlicheres und verlasslicheres diagnostiches und prognostisches Mittel bildet als die Prozentzahl der pathologischen Granulation.*"

### 6. SEDIMENTATION RATE OF THE ERYTHROCYTES

This test was introduced by the obstetrician, Fåhraeus, in 1918, although Grodinsky has pointed out that several previous observers had noted the rapid settling of the erythrocytes in pathological bloods. Partly because the test was introduced by an obstetrician and partly because the range of delicacy of the test is peculiarly adapted to obstetrical and gynecological cases, the sedimentation rate has been chiefly applied in these fields.

Wintrobe (1933) presents a new instrument whereby one can determine the sedimentation rate, volume of packed red cells, leucocytes and platelets, and icteric index at the same time. A perusal of the literature indicates that the sedimentation rate is not so applicable to the diagnosis of surgical infections as are the hæmogram and nuclear indices. Schilling (1929) states in this connection that "the acute infection or exacerbation, the progressive and more active process is reflected in the hæmogram, while the latent chronic infections sometimes are better expressed in the sedimentation reaction." Varga (1929), after discussing the effects of various factors on the sedimentation rate, concludes "*Die Untersuchung der Senkungsgeschwindigkeit hat uns sowohl in diagnostischer als auch in prognostischer Hinsicht viel weniger zu sagen als das Blutbild.*"

### 7. MISCELLANEOUS REACTIONS

*Changes in the serum.* The series of tests used collectively by McDonagh have so far been applied only to chronic conditions. These tests include an observation of the colloidal dispersion of the blood under the ultramicroscope, determinations of blood sugar,

urea, viscosity and refractive index. From the results of these determinations bloods are divided into hydrated, normal, and dehydrated varieties and treatment given accordingly. The writer will not attempt to give an appraisal of these tests except to say that at present they have little application to acute surgical infections.

*Leucocyte reaction of D'Amato.* This reaction was introduced by D'Amato in 1921 and was derived from Widal's hæmoclastic crisis reaction. It was first applied to tuberculosis, later to various types of infections and in 1927 to syphilis. At present the reaction has no application to surgical infections.

*Iodophilia.* Locke (1902) noticed that blood in inflammatory conditions gave a reaction with iodine. The presence and intensity of this reaction have been used in diagnosis. At present this method is little used.

*The guttadiaphot.* The guttadiaphot as used by Schilling and others consists in applying drops of venous blood directly from a syringe to three strips of paper of different color which are held in a frame of cardboard and examined the next day. By the corona of color formed around the drops of blood the diagnosis is made. At present the method has no surgical applications, being used only in chronic infectious diseases.

## STUDY OF CASES

The writer has used the Schilling hæmogram in a series of 33 cases during the past year. The cases to which the hæmogram was applied were selected in most instances because of some difficulty in the clinical diagnosis. This small series has the merit that it includes every case in which the hæmogram was used by the writer during this period of time. These cases are presented as illustrations of the merits and limitations of the hæmogram.

The writer uses an index called the toxic index (TI) which is based upon the Schilling hæmogram. This index may be defined as

$$TI = \frac{10My + 5J + 2(S - 10)}{10E + 2L + A}$$

where $My$ = myelocytes, $J$ = juveniles, $S$ = excess of staff forms over ten (the arbitrary upper limit of normal), $E$ = eosinophiles, $L$ = lymphocytes and $A$ = adult polymorphonuclear neutrophiles. The multiplication factors for each cell type were arrived at arbitrarily and are considered to represent the relative importance of these respective cells. The index is zero in normal persons and by definition cannot be negative. It is positive in infections.

Toxic index 0.00–0.25 = mild infection
Toxic index 0.25–1.00 = moderate infection
Toxic index 1.00 and above = severe infection

This index is essentially a method of expressing the Schilling hæmogram by one arithmetical figure. It is quite probable that the formula can be improved upon. At present it fails entirely to indicate the true condition in septic granulopenia and to a certain extent is inadequate in parasitic infections. Originally this index was termed an index of infection, but since it may be markedly positive in non-infective toxic conditions as will be shown later, the designation toxic index seems preferable.

In Table II are presented the temperature readings and blood findings in 5 cases. In all 5 cases the hæmogram and the toxic index were essentially normal and subsequent events proved that there was no indication for operative interference from the standpoint of infection alone.

CASE 1 represents an instance of suspected acute appendicitis, but further history indicated acute alcoholic gastro-enteritis which was confirmed by the negative blood findings. Case 2 represents renal colic with a high total leucocyte count but normal hæmogram. After a brain tumor removal, the question as to whether the persistent fever was of central or infectious origin arose in Case 3. The normal toxic index was substantiated by a subsequent uneventful convalescence. Case 4 represents an instance of Pick's pericarditic pseudo-cirrhosis in which despite fever and a high total leucocyte count the hæmogram indicated no infection and at operation no signs of inflammation were found. Case 5 represents a man, aged 69, with an infected wrist wound, lymphangitis, and axillary lymphadenitis. Because of the patient's age, a serious outcome was feared, but the blood findings and extremely mild subsequent course were concordant.

It is seen from Table II that in 5 cases with normal hæmograms there was no surgical infection. That the converse is not always

TABLE II.—NORMAL HÆMOGRAM IN FIVE CASES WITHOUT SURGICAL INFECTION[1]

| No. | Diagnosis | T | W.B.C. | E | B | My | J | S | A | L | Mo | TI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Enteritis | 98 | 6,000 | 1 | 0 | 0 | 0 | 11 | 43 | 40 | 5 | 0.01 |
| 2 | Renal colic | .. | 18,000 | 1 | 0 | 0 | 0 | 9 | 77 | 5 | 8 | 0.00 |
| 3 | Brain tumor | 102 | 13,000 | 1 | 2 | 0 | 0 | 9 | 39 | 46 | 3 | 0.00 |
| 4 | Polyserositis | 99 | 17,000 | 7 | 0 | 0 | 0 | 11 | 58 | 23 | 1 | 0.01 |
| 5 | Lymphangitis | 98 | 8,000 | 8 | 0 | 0 | 0 | 5 | 37 | 40 | 10 | 0.00 |
| | Same 1 day later | 98 | 9,000 | 11 | 1 | 0 | 0 | 5 | 50 | 24 | 9 | 0.00 |

T = average temperature
B = basophiles
S = staff cells
L = lymphocytes
W.B.C. = total leucocyte count
My = myelocytes
A = adult polymorphonuclear neutrophiles
Mo = monocytes
E = eosinophiles
J = juveniles
TI = toxic index

[1]Here, as throughout this paper, the term surgical infection denotes a localized collection of pus or other pyogenic or infective condition in which operative surgical interference is indicated, either to evacuate the pus or to remove the cause of the infection.

true is shown from a study of the 11 cases presented in Table III.

Cases 6 to 9 indicate that the hæmogram may be abnormal in malignant conditions either when receiving roentgen therapy or as an antemortem phenomenon. Cases 6 and 7 received roentgen therapy and Cases 8 and 9 represent 2 cases of carcinoma, 1 of the breast and 1 of the stomach. Despite the lack of marked infection or of terminal bronchopneumonia, both cases present marked antemortem shifts. In Case 8 bone marrow metastases may have been a factor in the production of the shift as is indicated by the presence of 3 per cent nucleated erythrocytes. The bones were not examined at necropsy. Case 10 is the one outstanding example in the entire series in which the hæmogram might have given misleading information. In this instance a perforated ulcer was suspected because of severe pain in a patient under ulcer management. Two days later he passed a stone *per urethram* and recovered. While the hæmogram is abnormal in this case it is not as much so as one would expect with a perforated peptic ulcer. In Case 11 a right subdiaphragmatic abscess was diagnosed clinically and roentgenologically. However, the very slight shift indicated the mildness of the infection and the patient recovered without operation. Again in Case 12 the hæmogram indicates the mild infection in a patient with acute prostatitis. Case 13 represents a man aged 65 with common duct stone and marked jaundice. Only the admission count is given in the table, the subsequent course of the toxic index being shown in Figure 2. It is a question as to whether this patient belongs in Table III as while he recovered temporarily without operation, the presence or absence of surgical infection is a matter of definition. Operation was performed several months later. Finally, Cases 14 and 15 show that, as is well known, the hæmogram may be abnormal in so called purely medical conditions. Case 14 represents a patient with ulcerative endocarditis and Streptococcus hæmolyticus septicæmia 2 days before death and Case 15 represents a patient who recovered from pneumonia. The similarity in the blood findings in these 2 cases indicates the difficulty in making a prognosis from the blood findings alone.

In Table IV is shown a definite change in the hæmogram in 10 cases of non-fatal surgical infection. A comparison of the toxic indices with those of the cases in Table II, where some of the patients presented just as marked clinical symptoms, shows the relatively high indices in the cases with definite surgical infection.

Cases 16 and 17 are examples of acute appendicitis, Case 17 being interesting in that the preoperative temperature and total leucocyte count were normal despite a pathologically verified very acute appendicitis. In Case 18 the presence of an appendiceal abscess or typhoid fever was suspected, the blood findings indicated an abscess, and this was found later at operation. Cases 19 and 20 represent

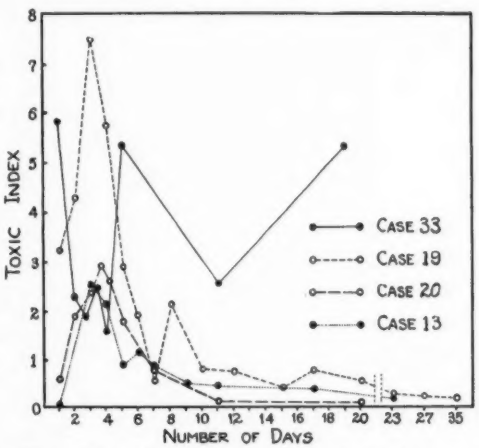


Fig. 2. The variation in the toxic index during the course of surgical infections. The unbroken line represents a fatal case and the broken lines represent 3 cases with recovery.

TABLE III.—ABNORMAL HÆMOGRAM IN ELEVEN CASES WITHOUT SURGICAL INFECTION

| No. | Diagnosis | T | W.B.C. | E | B | My | J | S | A | L | Mo | TI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Carcinoma | 100 | 9,200 | 4 | 0 | 0 | 6 | 37 | 41 | 4 | 8 | 0.93 |
| 7 | Hodgkin's disease | 98 | 6,000 | 1 | 0 | 0 | 0 | 26 | 59 | 8 | 6 | 0.38 |
| 8 | Carcinoma of breast | 98 | ..... | 0 | 0 | 1 | 10 | 45 | 25 | 14 | 5 | 2.45 |
| | Same, 2 days later | 98 | 12,000 | 0 | 0 | 1 | 8 | 38 | 33 | 12 | 8 | 1.88 |
| 9 | Carcinoma of stomach | 99 | 13,000 | 0 | 0 | 0 | 4 | 33 | 42 | 18 | 3 | 0.83 |
| | Same, 1 day later | 99 | 12,000 | 0 | 0 | 0 | 6 | 43 | 43 | 7 | 1 | 1.68 |
| | Same, 2 days later | 99 | 13,000 | 0 | 0 | 0 | 4 | 43 | 24 | 26 | 3 | 1.13 |
| | Same, 5 days later | 100 | ..... | 0 | 0 | 0 | 3 | 55 | 34 | 6 | 2 | 2.28 |
| 10 | Renal colic | 100 | 14,000 | 0 | 0 | 0 | 0 | 24 | 57 | 16 | 3 | 0.36 |
| | Same, 1 day later | 99 | 16,000 | 2 | 0 | 0 | 1 | 16 | 59 | 12 | 10 | 0.17 |
| 11 | Abscess (?) | 101 | 22,000 | 3 | 0 | 0 | 2 | 17 | 61 | 10 | 7 | 0.22 |
| | Same, 5 days later | 101 | 18,000 | 0 | 0 | 0 | 0 | 9 | 62 | 23 | 6 | 0.00 |
| 12 | Acute prostatitis | 101 | 10,000 | 1 | 0 | 0 | 0 | 23 | 35 | 32 | 9 | 0.24 |
| 13 | Cholelithiasis | 102 | 17,000 | 0 | 2 | 0 | 0 | 6 | 80 | 8 | 4 | 0.00* |
| 14 | Acute endocarditis | 103 | 14,000 | 1 | 0 | 0 | 4 | 45 | 38 | 9 | 3 | 1.39 |
| 15 | Pneumonia | 99 | 41,000 | 0 | 0 | 2 | 3 | 30 | 51 | 11 | 3 | 1.03 |

T = average temperature
B = basophiles
S = staff cells
L = lymphocytes
W.B.C. = total leucocyte count
My = myelocytes
A = adult polymorphonuclear neutrophiles
Mo = monocytes
E = eosinophiles
J = juveniles
TI = toxic index

*See Fig. 2 for subsequent course.

The patients in Cases 8 and 14 died within 2 days of the last hæmogram and the patient in Case 9 within 3 days.

children aged 7 and 10 years, respectively, with recovery despite an operative finding of perforated appendix with poorly localized peritonitis. The second of these cases is of special interest because of the correlation of the admission toxic index with the operative findings despite a normal temperature and a total leucocyte count of 7,700. In Table IV only the admission data for Cases 19 and 20 are given, detailed serial changes in the hæmogram being shown in Figure 2. Cases 21 and 22 represent 2 patients with acute appendicitis with recovery, the first being gangrenous. Case 23 is an example of a pelvic abscess, all counts being made after the exploratory laparotomy, and illustrate the slow convalescence. Two days after the last count recorded, a second abscess was found. In Case 24 the mild course of an alveolar abscess is followed. Case 25 represents a patient with an acute exacerbation of chronic osteomyelitis of the tibia, verified at operation. Case 26 represents a boy 17 years old with a perforated peptic ulcer that was so indefinite in its clinical symptoms that operation was not performed until 10 hours after admission. It is of interest that the initial smear taken 1 hour after the probable time of perforation showed no definite toxic cytoplasmic granulations while the hæmogram already showed a definite change. The next day there were very questionable toxic granulations and the third day a few more distinct toxic changes. This arbitrates again for the extreme latency of the cytoplasmic changes. In conclusion it may be said that all of the non-fatal surgical infections shown in Table IV produced a definite change in the hæmogram.

In Table V are presented the changes in the hæmogram in 7 cases of fatal surgical infection. These 7 cases all have markedly abnormal hæmograms and high toxic indices, the average of the highest toxic index being 7.56, whereas the average in the 10 cases with recovery shown in Table IV is 1.61. This would indicate that the toxic index has some value in prognosis as well as diagnosis. However, in 2 of the cases of fatal surgical infection, the toxic index was never as high as in 3 of the surgical infections with recovery.

The marked infection in a case of postoperative gas bacillus invasion of the abdominal wall is seen in the hæmogram of Case 27 taken 30 minutes before death. The previous day the total leucocyte count was 11,000. Case 28 represents a boy aged 3 years with primary pneumococcus peritonitis. The low total leucocyte counts associated with the marked shift are of interest. The polymorphonuclear neutrophiles in the peritoneal fluid at the time of death were almost entirely immature forms. Cases 29 and 30 represent patients with friable carcinoma of the rectosigmoid that were perforated at the time of operation with the production of pelvic peritonitis

TABLE IV.—ABNORMAL HÆMOGRAM IN TEN NON-FATAL SURGICAL INFECTIONS

| No. | Diagnosis | T | W.B.C. | E | B | My | J | S | A | L | Mo | TI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | Appendicitis | 99 | 19,000 | 0 | 0 | 0 | 0 | 21 | 68 | 6 | 5 | 0.27 |
| 17 | Appendicitis | 97 | 10,000 | 0 | 0 | 0 | 0 | 24 | 62 | 10 | 4 | 0.34 |
| 18 | Appendiceal abscess | 103 | 16,000 | 0 | 0 | 0 | 0 | 30 | 48 | 16 | 6 | 0.50 |
| 19 | Perforated appendix | 101 | 37,000 | 0 | 0 | 1 | 5 | 53 | 30 | 4 | 7 | 3.18* |
| 20 | Perforated appendix | 99 | 7,700 | 0 | 0 | 0 | 1 | 33 | 47 | 18 | 1 | 0.61* |
| 21 | Gangrenous appendix | 100 | 27,000 | 0 | 0 | 0 | 0 | 35 | 53 | 7 | 5 | 0.74 |
| | Same, 2 days later | 100 | 14,000 | 0 | 0 | 0 | 2 | 28 | 37 | 17 | 16 | 0.64 |
| | Same, 11 days later | 99 | 10,000 | 3 | 0 | 0 | 0 | 23 | 42 | 26 | 6 | 0.20 |
| 22 | Acute appendicitis | 100 | 20,000 | 0 | 0 | 0 | 1 | 52 | 39 | 3 | 5 | 1.98 |
| | Same, 4 days later | 101 | ..... | 0 | 0 | 0 | 1 | 27 | 54 | 14 | 4 | 0.47 |
| 23 | Pelvic abscess | 100 | ..... | 0 | 0 | 0 | 0 | 36 | 42 | 14 | 8 | 0.74 |
| | Same, 2 days later | 100 | 14,000 | 0 | 0 | 0 | 1 | 20 | 47 | 24 | 8 | 0.26 |
| | Same, 4 days later | 99 | 18,000 | 3 | 0 | 0 | 0 | 25 | 52 | 18 | 2 | 0.24 |
| | Same, 22 days later | 99 | 17,000 | 1 | 0 | 0 | 0 | 21 | 54 | 18 | 6 | 0.22 |
| 24 | Dental abscess | 99 | 12,000 | 0 | 0 | 0 | 0 | 21 | 51 | 21 | 7 | 0.23 |
| | Same, 3 days later | 99 | 10,000 | 0 | 0 | 0 | 0 | 13 | 57 | 22 | 8 | 0.06 |
| 25 | Osteomyelitis | 98 | 17,000 | 0 | 1 | 0 | 1 | 24 | 45 | 21 | 8 | 0.40 |
| | Same, 1 day later | 98 | 13,000 | 0 | 0 | 0 | 0 | 21 | 51 | 24 | 4 | 0.22 |
| | Same, 7 days later | 98 | 9,000 | 1 | 1 | 0 | 0 | 12 | 61 | 13 | 12 | 0.04 |
| 26 | Perforated ulcer | 98 | 14,000 | 0 | 0 | 0 | 2 | 22 | 58 | 9 | 9 | 0.45 |
| | Same, 1 day later | 100 | 14,000 | 0 | 0 | 0 | 1 | 24 | 57 | 7 | 11 | 0.54 |
| | Same, 2 days later | 100 | 11,000 | 0 | 0 | 0 | 0 | 23 | 59 | 11 | 7 | 0.32 |
| | Same, 4 days later | 99 | 10,000 | 2 | 0 | 0 | 1 | 13 | 54 | 17 | 13 | 0.11 |
| | Same, 11 days later | 99 | ..... | 1 | 0 | 0 | 1 | 5 | 58 | 27 | 8 | 0.04 |

T = average temperature
B = basophiles
S = staff cells
L = lymphocytes
W.B.C. = total leucocyte count
My = myelocytes
A = adult polymorphonuclear neutrophiles
Mo = monocytes
E = eosinophiles
J = juveniles
TI = toxic index

*See Fig. 2 for subsequent course.

and death. The marked difference in the extent of the shift in these 2 cases is interesting. In the first case Streptococcus viridans was the prevailing organism and in the second with the higher toxic index Streptococcus hæmolyticus. Case 31 represents a patient with carcinoma of the rectum treated by combined abdominoperineal resection. The initial rise in the toxic index corresponds to an infection of the perineal wound, and the terminal rise to a cysto-uretero-pyelonephritis. Case 32 represents a boy with a brain abscess who died of secondary meningitis a week after the last count was taken. Case 33 represents an adult with a perforated appendix and generalized peritonitis who presented such uncertain symptoms that operation was not performed until twenty-four hours after admission. The toxic index of 5.85 given in the table was determined several hours before operation. After a temporary improvement which is reflected in the decrease in the toxic index as shown in Figure 2, the patient developed a subdiaphragmatic abscess and died.

## RECAPITULATION

A study of the literature indicates that many of the indices devised to determine the presence and severity of infection cannot suitably be applied to surgical infections. The sedimentation rate of the erythrocytes is too labile a test to be satisfactory. Cytoplasmic toxic granulations follow the onset of an acute infection with a latent period that renders the observation of these changes of little value in acute surgical emergencies. Certain tests such as the guttadiaphot and the McDonagh determinations have no apparent field of usefulness whatsoever at the present time in acute infections, and others such as the leucocyte reaction of D'Amato have not been applied to any of the pyogenic infections either acute or chronic.

TABLE V.—ABNORMAL HÆMOGRAM IN SEVEN FATAL SURGICAL INFECTIONS

| No. | Diagnosis | T | W.B.C. | E | B | My | J | S | A | L | Mo | TI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | Gas infection | 103 | ..... | 0 | 0 | 7 | 28 | 16 | 26 | 14 | 9 | 4.11 |
| 28 | Pneumococcus peritonitis | 102 | 10,000 | 0 | 0 | 20 | 34 | 29 | 7 | 8 | 2 | 17.74 |
| | Same, 1 day later | 103 | 4,000 | 0 | 0 | 33 | 33 | 1 | 0 | 33 | 0 | 7.50 |
| 29 | Pelvic peritonitis | 99 | 18,000 | 0 | 0 | 1 | 5 | 48 | 33 | 7 | 6 | 2.36 |
| | Same, 1 day later | 100 | 22,000 | 0 | 0 | 0 | 4 | 55 | 28 | 5 | 8 | 2.89 |
| | Same, 2 days later | 98 | 20,000 | 0 | 1 | 1 | 5 | 46 | 31 | 6 | 10 | 2.49 |
| 30 | Pelvic peritonitis | 100 | 10,000 | 0 | 0 | 2 | 24 | 53 | 11 | 6 | 4 | 9.83 |
| | Same, 2 days later | 100 | 9,000 | 0 | 0 | 6 | 15 | 48 | 20 | 6 | 5 | 6.59 |
| | Same, 4 days later | 101 | 16,000 | 0 | 0 | 6 | 18 | 59 | 3 | 10 | 4 | 10.75 |
| | Same, 5 days later | 101 | 15,000 | 0 | 0 | 5 | 27 | 45 | 13 | 5 | 5 | 11.09 |
| | Same, 6 days later | 102 | 18,000 | 0 | 0 | 6 | 21 | 44 | 21 | 2 | 6 | 9.72 |
| | A.M., 7 days later | 103 | 16,000 | 0 | 0 | 4 | 33 | 44 | 16 | 1 | 2 | 15.72 |
| | P.M., 7 days later | 105 | 12,000 | 0 | 0 | 5 | 38 | 41 | 9 | 4 | 3 | 17.76 |
| 31 | Post op. infection | 99 | 15,000 | 0 | 0 | 0 | 0 | 17 | 75 | 4 | 4 | 0.17 |
| | Same, 1 day later | 99 | 13,000 | 0 | 0 | 0 | 1 | 12 | 65 | 16 | 6 | 0.09 |
| | Same, 7 days later | 98 | 26,000 | 0 | 0 | 0 | 2 | 35 | 41 | 9 | 13 | 1.02 |
| | Same, 8 days later | 98 | 23,000 | 2 | 0 | 0 | 0 | 37 | 42 | 7 | 12 | 0.71 |
| | Same, 10 days later | 100 | 12,000 | 0 | 0 | 0 | 1 | 32 | 46 | 16 | 5 | 0.63 |
| | Same, 12 days later | 99 | 14,000 | 0 | 0 | 0 | 0 | 30 | 50 | 19 | 1 | 0.45 |
| | Same, 16 days later | 99 | 18,000 | 0 | 0 | 0 | 0 | 38 | 46 | 7 | 9 | 0.93 |
| | Same, 19 days later | 99 | 16,000 | 0 | 0 | 0 | 1 | 40 | 45 | 8 | 6 | 1.06 |
| 32 | Brain abscess | 104 | 37,000 | 0 | 0 | 1 | 0 | 23 | 27 | 25 | 24 | 0.47 |
| | Same, 1 day later | 102 | 31,000 | 0 | 0 | 0 | 1 | 33 | 25 | 18 | 23 | 0.83 |
| | Same, 6 days later | 101 | 16,000 | 1 | 0 | 0 | 1 | 24 | 8 | 48 | 18 | 0.29 |
| | Same, 15 days later | 100 | 21,000 | 0 | 0 | 0 | 5 | 41 | 18 | 26 | 10 | 1.24 |
| 33 | Perforated appendix | 101 | 18,000 | 0 | 0 | 0 | 10 | 64 | 19 | 4 | 3 | 5.85* |

T=average temperature
B=basophiles
S=staff cells
L=lymphocytes
W.B.C.=total leucocyte count
My=myelocytes
A=adult polymorphonuclear neutrophiles
Mo=monocytes
E=eosinophiles
J=juveniles
TI=toxic index

The patient in Case 27 died within 30 minutes of the last hæmogram, the patients in Cases 28, 29, and 30 within 24 hours, Case 31 within 3 days and Case 32, 8 days.

*See Fig. 2 for subsequent course.

The total leucocyte count, the conventional differential count and various indices and combinations of the two although of considerable value are often misleading. A study of the nuclear changes in the polymorphonuclear neutrophiles gives a useful appraisal of the status of surgical infections. However, the Arneth count and its modifications are too complicated and pay too much attention to minute subdivisions that are off the scale of changes present in severe surgical infections.

The Schilling hæmogram seems especially adaptable to the diagnosis of surgical infections. A simplification of the hæmogram in the form of the percentage of non-filamented polymorphonuclear neutrophiles is often of value. To avoid confusion and for the sake of uniformity this percentage should be expressed as that of one hundred leucocytes. When, on the other hand, the percentage of non-filamented cells is expressed in terms of one hundred polymorphonuclear neutrophiles, the observer does not have the advantage of information obtained from changes in the other cells of the hæmogram.

The Schilling hæmogram may be expressed as a single arithmetical figure by using what is defined in this paper as the toxic index.

This index includes most of the factors in the complete hæmogram and its formula was determined after trying many similar formulæ. It might have been more accurate if a factor depending on the total leucocyte count were included, but to prevent too great complexity this was omitted. The multiplication factors in the formula were determined arbitrarily and are intended to indicate the relative importance of each cell.

The hæmogram was used in a series of cases that while small in number had the advantage of being consecutive and of considerable variety. The results obtained in this series of cases agree with those reported by other writers in similar cases. It is well known that the hæmogram should be used only as an adjunct to clinical examination. Furthermore, an increase in the toxic index is not limited to surgical infections and may occur in toxic states and as an antemortem phenomenon. There may be an increase in carcinomatous cases undergoing roentgen treatment and in any infection irrespective of whether or not surgical interference is indicated. The degree of change is not always indicative of the extent of the infection. The test is apt to be more misleading when used as a prognostic omen than when taken as a diagnostic indication, since certain patients may recover after a more marked shift than occurs at any time in other fatal cases.

However if these factors are all taken into consideration and the hæmogram is used in conjunction with observations of the pulse, temperature, respiration and clinical signs and symptoms, it gives confirmatory evidence as to the condition of the patient. In many instances the hæmogram is superior to certain well recognized tests, the most outstanding example being cases of overwhelming peritonitis where the total leucocyte count and the temperature may be both subnormal, but the toxic index increased with a reasonable degree of certainty. However, the hæmogram is advantageously more stable than the total leucocyte count under influence of pain and fear.

## CONCLUSIONS

1. Of 27 indices of infection studied in the literature, the Schilling hæmogram seems best suited for the study of surgical infections. Most of the factors in the Schilling hæmogram can be expressed as a single arithmetical figure by using what is defined in this paper as the toxic index.

2. An alteration in the hæmogram is not a specific indication of infection or that an infection which is present requires surgical interference, nor is the degree of alteration always proportional to the severity of the infection. But when used in its entirety or expressed as the toxic index and when taken in conjunction with clinical and routine laboratory examinations, the hæmogram adds definite confirmatory evidence as to the presence and course of surgical infections.

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# THE EFFECT OF THE GAMMA-RAY OF RADIUM ON WOUND HEALING[1]

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THE purpose of this investigation was to determine the effects of $\gamma$ radiation from radium on the healing of wounds. This problem has been approached previously, but in practically every instance the agent used was roentgen-radiation. The results reported are conflicting. The discrepancies can probably be explained by the marked variations in the techniques used.

L. Freund worked with humans and animals and found that when fresh wounds were subjected to a therapeutic dosage of X-ray, healing was somewhat more rapid than in individuals not treated in such a manner.

Fukase, using rabbits, made incisions 10 centimeters long on the backs of 14 animals and irradiated half of the length of the wound, the other half being protected with lead. The dosage was 8H (170 kilovolts) or 400 r. No sutures were used and it was found that in all animals the irradiated half healed by primary intention, while the control portion healed by secondary intention.

Buhtz, in studying the effects of X-rays on traumatic inflammation in dogs found that skin wounds exposed to 400 r (170 kilovolts) immediately after incision, in 24 hours revealed a better tendency toward healing than the control wounds.

F. Freund, in attempting to ascertain the influence of X-radiation on inflammation, used the same factors of experiment and same animals as Fukase, and corroborated his findings. In the irradiated half the inflammation was considerably less and healing took place more rapidly.

Maximow produced aseptic inflammation by implanting celloidin blocks into the subcutaneous tissue of the abdominal wall of rabbits and studied the effect of soft X-rays at various intervals in the reaction produced. He found that there was considerable depression in the usual reaction on the part of the fibroblasts. They did not multiply at all, or started very late, and often the division was atypical. The protoplasm and nucleus exhibited pathological hypertrophy and the capacity for collagen formation seemed to be lost. Œdema developed in the older connective tissue near the inflamed area and clotted fibrin appeared. The fibroblasts seemed incapable of recovering from their injury for a long time although in 2 months there was little difference from the control. Old connective tissue cells were found unchanged by radiation. No distinctive qualitative changes were found in the leucocytes and polyblasts.

Pohle and his collaborators, using rats, made incisions on the backs of the animals and irradiated half of the incision, protecting the other half with lead. The dosage delivered was 1000 r at a single sitting. Two separate wave lengths and filtrations were used, but no marked difference could be detected between them (100 kilovolts, 2.0 millimeters aluminum, and 140 kilovolts, 0.25 millimeters copper 1 millimeter aluminum). One group was treated immediately after incision, a second group 24 hours after, and a third group at the 48 hour interval. Sections were removed on the seventh day after operation and upon complete healing of the wounds. In all cases they noted a definite retardation in healing in the irradiated portion, although exposure after 24 hours seemed to have the most pronounced inhibitory effect. In a second study they repeated the above experiments, except that in this instance sections were taken at daily intervals of from 1 to 9 days after incision. The factors used were 100 kilovolts, 2.0 millimeters aluminum. The findings were similar to those of the first experiments. In no instance, however, did this slowing of the healing process interfere with the final formation of a smooth scar.

The differences in reaction obtained by the various authors may be explained by the total dosage given to the wounds. Whereas, in one instance small to moderate doses accelerated healing, in the other, larger doses

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definitely depressed it. A second factor, which may account for the difference, is that different animals were used.

These points were, therefore, kept in the foreground when the experiments listed below were undertaken to ascertain the effects of the γ-ray of radium rather than that of the X-ray on wound cicatrization.

### METHOD OF EXPERIMENT

Dogs were chosen as the experimental animal in preference to the rabbits and rats used by other workers for the following reasons: First, it is possible to make many more incisions on a dog than on the smaller animals, thus enabling one to make more accurate comparisons both as regards the irradiated areas as well as the controls. Second, it obviates to a certain extent the necessity of using many animals for single experiments, thereby eliminating individual reactions as much as possible.

In all animals, certain factors of radiation were constant, the only variables being the dosage and the time interval. A plaque measuring 2.8 centimeters by 1.8 centimeters containing 200 milligrams of radium element was used. The filtration was 1 millimeter of platinum and the distance was 7 millimeters. Before proceeding with the experiments we determined the erythema dose for the dog's skin and found it to average 1,500 milligram hours. This was performed in 5 dogs.

Fifteen dogs were used and were divided into 5 groups of 3 each. In all animals the abdomen was carefully shaved and prepared and under intravenous nembutal anæsthesia 10 incisions 3 centimeters each in length were made down to the rectus fascia. Five of these were placed on either side of the abdomen extending from just below the costal margin to the iliac crests. They were equidistant from each other and from the midline so that each opposing incision was in a corresponding site, i.e., symmetrically situated. The wounds were immediately closed with interrupted black silk sutures, which were removed on the fifth day after operation. The wounds on one side of the abdomen were radiated and the corresponding wounds on the other side were used as controls. All incisions with the exception of the one being irradiated were protected with lead.

Group 1a. Three dogs. Each of five incisions on the left side of the abdomen in each dog was given 50 milligram hours immediately after operation with the plaque described previously. At the end of the third day the highest incision with its control was removed for gross and microscopic examination. The other irradiated incisions together with their controls were removed from above downward on the fifth, ninth, fourteenth, and twenty-second day, respectively.

Group 1b. Three dogs. The same procedure as in the previous group was followed, except that a dosage of 100 milligram hours was delivered to each of five areas immediately after operation.

Group 2a. Three dogs. In this instance the total dosage given immediately after incision to each of five areas was varied. Fifty, 100, 250, 500, and 1000 milligram hours were delivered to the wounds, respectively, from above downward. The five irradiated incisions together with their controls were removed for section on the seventh day after operation.

Group 2b. Three dogs. The same procedure was used as in the last group except that the incisions were irradiated 24 hours after operation and the wounds as before were removed on the seventh day after operation.

Group 2c. Three dogs. The incisions were irradiated as the two previous groups except that it was done 48 hours after operation.

### RESULTS

A general summary of the results will be given for each group instead of for the individual animal, except in those cases in which there was a marked difference in reaction.

Group 1a. In this group, both *in situ* and after excision of the wound, gross examination revealed an apparently increased healing activity in the irradiated wounds as compared to the controls. This was true regardless of the day the sections were taken. These findings were confirmed on histological examination.

In the sections taken 3 to 5 days after incision the healing process was farther advanced than the non-irradiated controls as evidenced by greater and more mature fibroblastic activity and a milder inflammatory reaction. In the sections taken later the irradiated wounds revealed a greater amount of connective tissue. For example, an irradiated section taken on the fifth day was as far advanced in healing as was an average healing wound on the seventh day. In the sections taken 22 days after incision little difference could be detected in the irradiated and non-irradiated areas with the possible exception of later and more fibrosis and hyalinization in the former (Fig. 1 and Table I).

TABLE I.—GROUP 1a*

| Dog | Day | Irradiated incision | Non-irradiated control |
|---|---|---|---|
| 1 | 3 | Rapid healing | Average healing |
| | 5 | Almost healed | Average healing |
| | 9 | Young scar | Healed |
| | 14 | Scar | Scar (not mature) |
| | 22 | Scar | Scar |
| 2 | 3 | Rapid healing | Average healing |
| | 5 | Healed | Average healing |
| | 9 | Young scar | Healed |
| | 14 | Scar | Scar (not mature) |
| | 22 | Scar | Scar |
| 3 | 3 | Rapid healing | Average healing |
| | 5 | Almost healed | Average healing |
| | 9 | Young scar | Healed |
| | 14 | Scar | Scar (not mature) |
| | 22 | Scar | Scar |

Rapid healing—Many young fibroblasts, inflammatory reaction subsiding, new blood vessel formation.
Average healing—Inflammatory reaction preponderant. Later, inflammation subsiding, more fibroblasts and blood vessels.
Almost healed—Many fibroblasts, early connective tissue formation, still foci of leucocytes.
Healed—Fewer fibroblasts, connective tissue fibers increased, no leucocytes.
Young scar—Blood vessels still present, connective tissue preponderant.
Scar—Much connective tissue, beginning hyalinization.

*Plaque 2.8 by 1.8 cm.—Filtration 1 mm. platinum—Distance 7 mm. Dosage—50 milligram hours immediately after incision

TABLE II.—GROUP 1b*

| Dog | Day | Irradiated incision | Non-irradiated control |
|---|---|---|---|
| 4 | 3 | Rapid healing | Average healing |
| | 5 | Almost healed | Average healing |
| | 9 | Young scar | Healed |
| | 14 | Scar | Scar (not mature) |
| | 22 | Scar | Scar |
| 5 | 3 | Rapid healing | Average healing |
| | 5 | Healed | Average healing |
| | 9 | Young scar | Healed |
| | 14 | Scar | Scar |
| | 22 | Scar | Scar |
| 6 | 3 | Rapid healing | Average healing |
| | 5 | Healed | Average healing |
| | 9 | Young scar | Healed |
| | 14 | Scar | Scar |
| | 22 | Scar | Scar |

See Table I for description of terms.

*Plaque 2.8 by 1.8 cm.—Filtration 1 mm. platinum—Distance 7 mm. Dosage—100 milligram hours immediately after incision

Group 1b. In this instance the findings were essentially the same as the previous group (Fig. 1 and Table II).

Group 2a. It was found both grossly and microscopically that with doses up to and including 250 milligram hours, healing was definitely more advanced in the irradiated areas. With doses of 500 and 1000 milligram hours, there was much less fibroblastic reaction, but more inflammatory reaction and some necrosis in the irradiated areas. Healing was therefore definitely retarded as compared to the incisions treated with smaller doses and to the non-irradiated sections (Fig. 2, Table III).

TABLE III.—GROUP 2a*

| Dog | Milligram hours | Irradiated incision | Non-irradiated control |
|---|---|---|---|
| 7 | 50 | Well healed | Healed |
| | 100 | Well healed | Healed |
| | 250 | Well healed | Healed |
| | 500 | Retarded healing | Healed |
| | 1000 | Little evidence of healing | Healed |
| 8 | 50 | Well healed | Healed |
| | 100 | Well healed | Healed |
| | 250 | Healed | Healed |
| | 500 | Retarded healing | Healed |
| | 1000 | Little evidence of healing | Healed |
| 9 | 50 | Well healed | Healed |
| | 100 | Well healed | Healed |
| | 250 | Well healed | Healed |
| | 500 | Retarded healing | Healed |
| | 1000 | Little evidence of healing | Healed |

Well healed—Blood vessels present, very few fibroblasts, connective tissue fibers abundant.
Retarded healing—Inflammation present, fibroblasts proliferating, few connective tissue fibers.
Little evidence of healing—Very few fibroblasts, inflammation preponderant, no connective tissue.

*Plaque 2.8 by 1.8 cm.—Filtration 1 mm. platinum—Distance 7 mm.—Varying dosages. Wounds irradiated immediately after incision. Sections taken on seventh day after operation.

Group 2b. In this group it was noted that even in the smallest doses the healing process was retarded in the irradiated areas, the degree of retardation varying directly with the increase in dose, it being most marked when greater dosages had been given (Fig. 3). In 1 of the 3 dogs in this group the irradiated incisions were still not healed on the seventh day while the controls were fairly well healed. Hence, because of the obvious gross findings, sections were not taken for a histological examination. In this animal it was further found that the irradiated wounds had healed completely by the fourteenth day. Sections of both the irradiated areas and control areas on this day revealed little difference grossly except that the scar in the irradiated wounds was thinner and of finer texture. This observation was confirmed by a microscopic examination in which it was found that there was much less fibrosis in the irradiated group (Fig. 4 and Table IV).

Group 2c. In this group there was very little difference in the wounds irradiated with 50 and 100 milligram hours and the non-irradiated incisions. Those wounds irradiated with 250 and 500 milligram hours showed a tremendous new connective tissue

TABLE IV.—GROUP 2b*

| Dog | Milligram hours | Irradiated incision | Non-irradiated control |
|---|---|---|---|
| 10 | 50 | Retarded healing | Healed |
| | 100 | Retarded healing | Healed |
| | 250 | No evidence of healing | Healed |
| | 500 | No evidence of healing | Healed |
| | 1000 | No evidence of healing | Healed |
| 11 | 50 | No evidence of healing Wound open | Healed |
| | 100 | No evidence of healing Wound open | Healed |
| | 250 | No evidence of healing Wound open | Healed |
| | 500 | No evidence of healing Wound open | Healed |
| | 1000 | No evidence of healing Wound open | Healed |
| 12 | 50 | Retarded healing | Healed |
| | 100 | Little evidence of healing | Healed |
| | 250 | No evidence of healing | Healed |
| | 500 | No evidence of healing | Healed |
| | 1000 | No evidence of healing | Healed |

Retarded healing—Inflammation predominating, fibroblasts increasing no connective tissue.
Little evidence of healing—Very few fibroblasts, inflammation preponderant, slight necrosis.
No evidence of healing—Marked inflammatory reaction, no fibroblasts, necrosis.

*Plaque 2.8 by 1.8 cm.—Filtration 1 mm. platinum—Distance 7 mm.—Varying dosages. Wounds irradiated 24 hours after incision. Sections taken on seventh day after operation.

TABLE V.—GROUP 2c*

| Dog | Milligram hours | Irradiated incision | Non-irradiated incision |
|---|---|---|---|
| 13 | 50 | Healed | Healed |
| | 100 | Healed | Healed |
| | 250 | Almost healed† | Healed |
| | 500 | Almost healed† | Healed |
| | 1000 | Little evidence of healing | Healed |
| 14 | 50 | Healed | Healed |
| | 100 | Healed | Healed |
| | 250 | Almost healed† | Healed |
| | 500 | Almost healed† | Healed |
| | 1000 | Little evidence of healing | Healed |
| 15 | 50 | Healed | Healed |
| | 100 | Almost healed | Healed |
| | 250 | Almost healed† | Healed |
| | 500 | Almost healed† | Healed |
| | 1000 | Little evidence of healing | Healed |

*Plaque 2.8 by 1.8 cms.—Filtration 1 mm. platinum—Distance 7 mm.—Varying dosages. Wounds irradiated 48 hours after incision. Sections seventh day after operation.

†Marked fibroblastic proliferation, but not as far advanced in healing as controls.

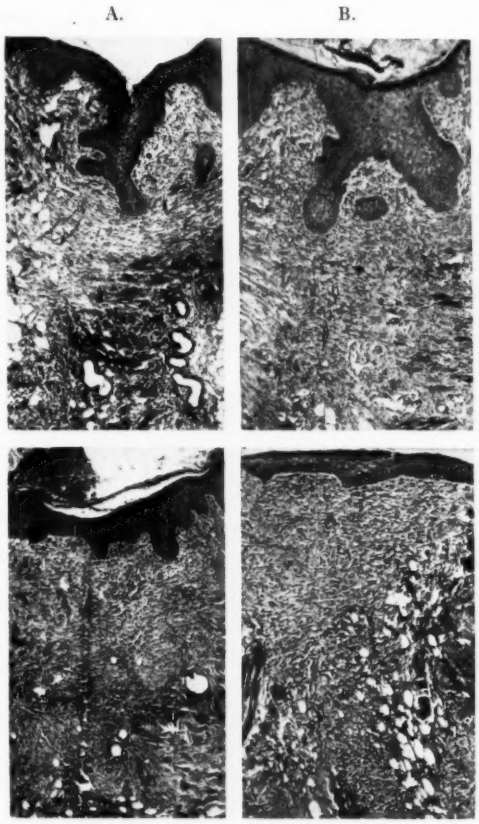


Fig. 1. Group 1a. A, Irradiation wound (50 milligram hours immediately after operation). Section on fifth day after operation. Note increased fibroblastic proliferation in contradistinction to control area B. Group 1b. C, Irradiated wound (100 milligram hours immediately after operation). Section on ninth day after operation. Note older connective tissue in contradistinction to control area D.

formation and rich organization tissue in contrast to the controls, which did not show nearly as much fibroblastic proliferation although they were more advanced in the healing process. In the region of the wounds receiving 1000 milligram hours, healing was incomplete, whereas the non-irradiated areas were in an advanced state of healing (Fig. 5, Table V).

On examination of the wounds, both grossly and histologically, it was found that those wounds irradiated with small doses immediately after incision showed a definite acceleration in the healing process or a shortening of the so-called "lag period"; whereas

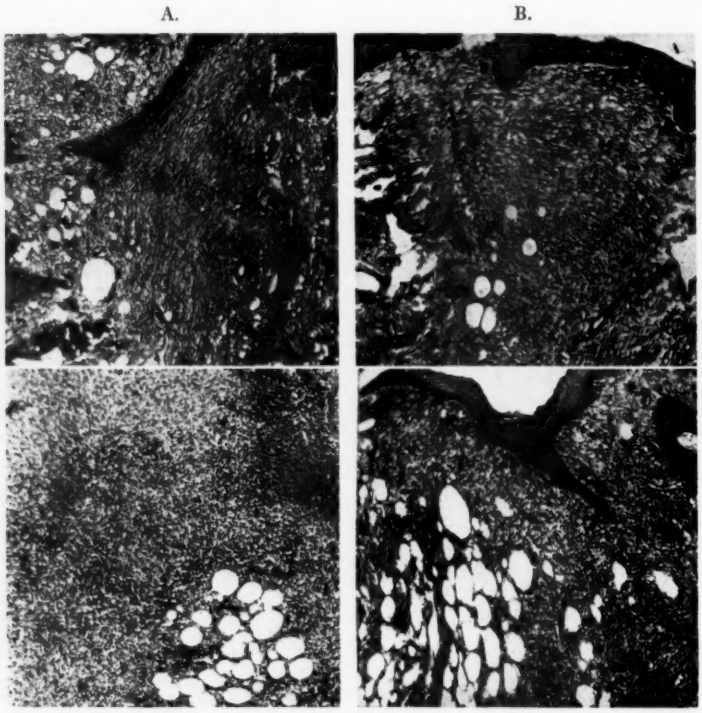


Fig. 2. Group 2a. A, B, and C (50, 100, 1000 milligram hours, respectively, immediately after incision). Section on seventh day after operation. A and B, Note increased fibroblastic proliferation. C, Note marked inflammatory reaction, necrosis, and absence of healing. D, Control.

those wounds treated with higher doses revealed a definite retardation. This was found to be true, however, for only those irradiated at the time of incision.

Those wounds irradiated 24 hours after incision showed the most marked deviation from the controls. Healing was definitely depressed and in some cases markedly so after any dosage, large or small. These findings correspond with those of Pohle and his associates. However, in their work they used a set dosage of 1000 r units with X-ray as contrasted with the varying dosages with radium used in these experiments.

In those wounds exposed 48 hours after cutting, it was found that in the smaller dosages, no difference could be detected between the irradiated and non-irradiated sections. It is interesting to note that moderate doses caused a marked plastic reaction far in excess of that shown in the controls although the latter were more advanced in actual healing. In the higher doses the process was definitely depressed.

Certain other observations which have been made by Pohle and others have also been made in these cases. First, the irradiation had less effect on epithelial growth than it did on deeper tissues; second, it was seen that the superficial layer of the connective tissue was more affected than the deeper layer. This latter is explained on the basis of the absorption law and is true whether the process is proliferative or inhibitory.

A significant finding because of its applicability to the treatment of keloids and hypertrophic scars may be mentioned here. It is briefly this: In those wounds exhibiting a

A. B. C.

Fig. 3. Group 2b. A and B (50 and 250 milligram hours, respectively, 24 hours after incision). Section seventh day after operation. A and B, Note marked inflammatory reaction and absence of healing. C, Control.

definite delay in cicatrization it was noted that the final scar was as well healed as was the control. Examination revealed a scar of more delicate connective tissue fibers as well as a decrease in the number of fibers and hyalinized structures. These observations have been made by others. It is possible, therefore, to surmise that in those individuals who show a tendency to hypertrophic scar and keloid formation, treatment should be directed with suitable doses at an optimum time after operation so as to prevent excessive fibroblastic formation as well as the laying down of excess collagen.

It may be assumed from what has been said that when wounds are irradiated immediately after the incision, the process follows the Arndt-Schultz law, i.e., large doses depress, small doses stimulate. This does not hold, however, when the wounds are exposed to radiation 24 and 48 hours after incision. Several theories have been expounded as to the action of irradiation on the healing mechanism. It may be well to enumerate a few.

Bab believes that the mechanism may be similar to that in the irradiation of malignant growths, namely, that the rays influence tissue containing histamine. This is highly speculative and no evidence is presented in support of it.

F. Freund, in studying the effects of radiation on inflammation, found that X-rays inhibit exudation and decrease the number of inflammatory cells. This would then allow for more rapid healing. He stated that in inflammation the inflammatory cells are either evacuated or destroyed by absorption or phagocytosis, or may become transformed into connective tissue cells which bring about healing. The action of the rays may destroy the inflammatory cells more quickly or transform them into connective tissue cells.

L. Freund states that it is a question as to whether the influence is due to the stimulating effects of small doses of X-rays on the function and growth of the cells, or whether it is to be traced back to the elimination by the rays of an antagonistic factor which delays cicatrization.

Fukase believes that the explanation is in the inhibitory effect of the ray on those leucocytes possessing oxyphilic granules.

The writer is of the opinion that no definite statement can be made regarding this phenomenon as it is difficult to determine if the resultant action is due to depression of the inflammatory process, or stimulation of the connective tissue cells or to both in the case of smaller dosage. The reverse process may be true when larger doses are used.

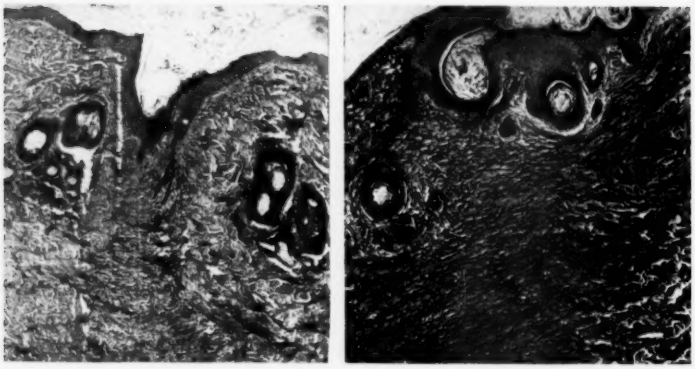

Fig. 4. Group 2b. A, left (250 milligram hours 24 hours after incision). Wound open on seventh day after operation. Section taken sixteenth day after operation. Note fine texture of scar. B, Control. Note marked growth of connective tissue.

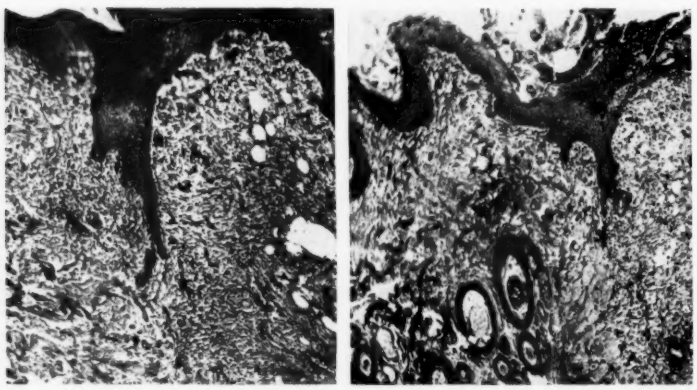

Fig. 5. Group 2c. A, left, 500 milligram hours, 48 hours after incision. Note marked fibroblastic proliferation. B, Control. Note older connective tissue.

From the evidence accumulated by Maximow and from observations in these experiments it is believed that in those wounds irradiated immediately after incision, the following may be the explanation. In the smaller dosages where acceleration of healing was obtained, it is possible that this amount stimulates the tissue itself to the production of a greater and more active group of plastic cells than normally. In larger doses, this function is depressed because of injury to the tissue cell and the inflammatory reaction gains the upper hand at the expense of the fibroblasts, thus delaying healing.

Another possibility to be considered in this regard is on the basis of radiation retained by the tissue itself after it has been irradiated. It is possible that in the case of smaller doses, enough radiation is retained by the tissue to stimulate the new cells which are formed to take part in healing. In larger doses the radiation retained is still sufficient to retard the activity of these cells.

In those wounds irradiated 24 hours after incision it is assumed that the precursors of the fibroblasts and the connective tissue cells have already formed. They are undoubtedly in a very embryonic form and hence are extremely sensitive to radiation of any degree, thereby causing retardation in the growth of the connective tissue fibers.

In those wounds irradiated 48 hours after

incision the fibroblasts may be old enough not to be affected by small amounts of radiation. In moderate doses they may be stimulated by the rays as is evidenced by the excessive reaction seen in the sections. They are probably not strong enough to withstand larger doses and as a result there is destruction of some of the weaker cells and a retardation in activity of the more vigorous ones.

## SUMMARY

1. Wounds produced in 15 dogs were treated with varying dosages of the $\gamma$-ray of radium at different time intervals with fixed distance and filtration to ascertain the effects of this type of radiation on the healing process.

2. Acceleration of healing was observed in those wounds which were exposed to small and moderate doses immediately after incision. Retardation was noted in those wounds receiving higher doses.

3. Retardation of healing was noted in all wounds exposed to any dose of radiation 24 hours after incision, the degree varying directly with the dose.

4. When the wounds were subjected to varying doses 48 hours after incision, retardation effects were noted by the use of the higher doses and no change was seen with the smaller doses.

5. The retardation in healing did not interfere with the formation of a smooth scar.

The author is highly indebted to Drs. Max Cutler and A. C. Ivy for their suggestions in the preparation of this paper and to Dr. Otto Saphir for his aid in the interpretation of the microscopical sections.

TABLE VI.—GENERAL SUMMARY OF RESULTS

| | No. dogs | Milligram hours | Hours post-operative | Effect |
|---|---|---|---|---|
| 1a | 3 | 50 | 0 | Hastened |
| b | 3 | 100 | 0 | Hastened |
| 2a | 3 | Hastened: 50, 100, 250 — Retarded: 500, 1000 | 0 | |
| b | 3 | 50, 100, 250, 500, 1000 | 24 | All retarded |
| c | 3 | No effect: 50, 100 — Proliferation: 250, 500 — Retarded: 1000 | 48 | |

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# CLINICAL SURGERY

*FROM THE HARVARD UNIVERSITY DENTAL SCHOOL*

## DENTAL PROSTHESIS IN RELATION TO FACIAL REPARATIVE SURGERY[1]

V. H. KAZANJIAN, M.D., F.A.C.S., BOSTON

REPARATIVE surgery and dental prosthesis have for centuries been used separately and in an unrelated way for the repair of facial defects and deformities arising from accidents, destructive diseases, and congenital cleft palate. But it is only within recent years that the advantages of combining these two methods have been realized. Going back to documents written possibly three thousand years ago by the ancient Hindus, we find complete descriptions of operations for the restoration of missing parts of the nose which are, even today, widely used as standard procedures. And during succeeding centuries, the literature of medicine contains many references to plastic surgery. Artificial replacement of missing parts has likewise been practiced since the early days of the healing art, and it, likewise, has an ancient and honorable tradition. Yet it was not until the World War that the benefits to be derived from co-operation of effort between these two specialties of the restorative art became apparent, and upon this foundation of experience a new field has sprung up, the potentialities of which have by no means been fully realized.

Fig. 1. Case 1.

Facial deformities resulting from war, accidents, disease or what not, have always existed, and under the living conditions of modern civilization, we cannot regard them as likely to diminish in number. Great progress in the methods of treating these conditions has been made since the War, but there is still room for further improvement of this service, owing to the part which dentistry can play in helping to solve the complicated problem.

Much facial restorative work today is being done by general surgeons because, as a rule, oral surgeons have not essayed the treatment of extensive and complicated facial deformities. This means, of course, that most of the reconstructive surgery of the face is being done by men who are often unaware of the aid to be derived from dental prosthesis. Unless the surgeon himself happens to be dentally trained, a rare coincidence, the desirability of securing co-operation from some competent dentist becomes, therefore, apparent. To point out what dental prosthesis can contribute in the correction of deformities of the face and jaws is my purpose in this paper.

### CLASSIFICATION OF CASES

The cases to be considered fall readily into three groups, classified on the basis of their genesis as follows: traumatisms, destructive diseases, and congenital defects and deformities. Under traumatisms are grouped the fractures of the maxilla, mandible, nasal and malar bones arising from automobile accidents, athletic games, etc.; lacerations of the soft tissues which generally accompany fractures and occasionally result from burns, bruises, or superficial injuries; and gunshot wounds. Under destructive diseases are included deformities resulting from treatment of the new-growths, osteomyelitis, lues, and lupus. Under congenital defects are included cleft palate and harelip.

[1]Read before the Dental Section of the American Association for the Advancement of Science; meeting of the American College of Dentists, Atlantic City, December 30, 1932.

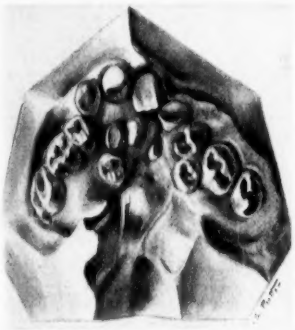


Fig. 2. Case 1.

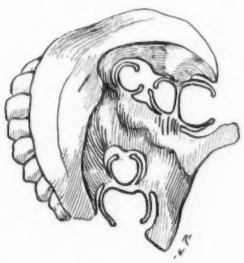


Fig. 4. Case 1.

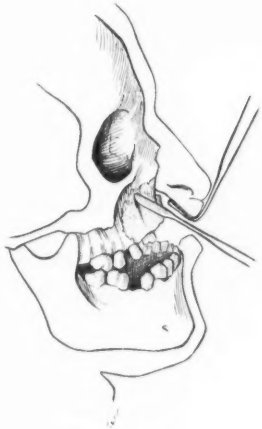


Fig. 3. Case 1.

The advantages of dental prosthesis in relation to the treatment, surgical, prosthetic, or both, of the conditions mentioned may be summarized as follows. In the treatment of traumatisms, the prosthetic appliance can be used most successfully for the immobilization of fractures; to prevent adhesions and cicatrization resulting from face injuries and lacerations; and to restore the bony framework of the face where missing. In treating destructive diseases, such as cancer and lupus, prosthesis is valuable to restore missing noses, orbits, ears, and other tissues which have been lost through disease or the radical treatment of it, and also to provide support for tissue grafts in plastic surgery. In treating congenital cleft palate, the appliance will improve speech and restore the contour of the face if the maxilla is underdeveloped, as is often the case.

### DETAILED CONSIDERATIONS

In the field of fractured jaws, the gradual development from crude beginnings to the more precise and refined methods of immobilization of today has resulted in splints that are far superior to what the general surgeon has ever known. Thus today this branch of traumatic surgery is generally entrusted exclusively to the oral surgeon. Formerly, when treating fractured jaws, the general surgeon resorted to external bandaging, or in the more severe cases, to open reduction of the fracture. These methods, while efficient enough for some cases, have proved to be inadequate in more complicated ones, and again the importance of the occlusal relationship of the teeth was very often neglected, thereby, inhibiting their normal use in mastication.

Dental methods of fixation of fractures are based upon the following principles. Splints are designed to use existing teeth and alveolar processes as points of anchorage and to re-establish the normal occlusion of the teeth as the fundamental point in the process of immobilization. It is true that the methods of utilizing teeth by ligation have been practiced since the time of Hippocrates in the fifth century before Christ, but it remained for the dentist to recognize the great possibilities of the procedure and to devise various types of splints for specific purposes. Prosthetic dentistry contributed to this development, for, before the discovery of vulcanite, metal splints were used as early as 1780 by Chopert and Desault. From

Fig. 5. Case 1.

Fig. 6. Case 2.

orthodontia, however, have come more simple and efficient methods of fixation of fractures by means of retention bands and maxillary wires. In mentioning the importance of dental technical methods in the treatment of fractured jaws, it is not my intention to minimize the contributions of surgery. The modern treatment of such injuries has grown up in reality from the accumulated knowledge of both dentist and surgeon.

In many cases of tissue injuries to the face and mouth, prosthetic appliances, if adjusted immediately after the accident or operation, will forestall adhesions and prevent the contractions that result from the formation of cicatricial tissue, thus assisting to restore the normal contour of the face. Claude Martin was probably the first person to devise ingenious appliances and adjust them immediately after operations for the treatment of disease and accidents in the mouth. While I consider his appliances too complicated in construction and not suitable to our present methods of surgical technique, yet I have followed for many years his principle of immediate insertion of prosthesis, and generally with very satisfactory results. Unfortunately, either from lack of facilities or from a scarcity of trained men, this procedure is not followed universally, but I can recommend it heartily.

Fig. 7. Case 2.

As has been pointed out before, prosthesis can materially assist in the problem of restoring missing noses, orbits, ears, and the bony framework of the face and jaws, where they have been lost through destructive diseases, serious accidents, and especially gunshot wounds. In this connection the far-reaching results of malignant disease are greatly to be feared. The stubborn and progressive nature of carcinoma is familiar to all, and it is unfortunately true that at present our only positive means of combating this dread disease is based upon a mode of treatment that results in still greater destruction of tissue.

Fig. 8. Case 3.



Fig. 9. Case 3.

Fig. 13. Case 3.

Fig. 14. Case 3.

Fig. 10. Case 3.

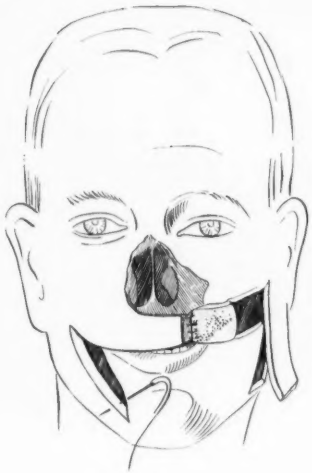


Fig. 11. Case 3.

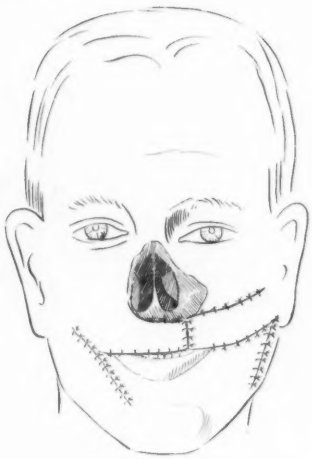


Fig. 12. Case 3.

Following the successful treatment of carcinoma, many problems associated with the efforts to repair and restore are encountered. First of all is the problem of supplying new tissue and possibly underlying support. Second, most of these patients are past middle age, and on account of a reduced vitality are unable to meet the strain of repeated operations. Third, a permanent cure is never assured. Fourth, patients may reside many hundreds of miles from a center of treatment and lack the means necessary for transportation and hospitalization. A surgeon facing these handicaps is generally obliged to follow the course most compatible with the circumstances.

The treatment of these deformities must be either by surgery or prosthesis, or in some instances, a combination of both. In general, the loss of soft tissues of the face, such as eyelids, lip, cheeks, or part of the nose, may be treated by plastic surgery, while massive destruction of the maxilla and mandible, and often the total destruction of the nose, are best corrected by prosthetic means, possibly aided by various operations to fit the individual case.

Artificial noses are constructed of vulcanite rubber. I consider this material well suited for the purpose. Great care should be exercised in molding the shape of the nose, bearing in mind that it must harmonize with the contour of the surround-

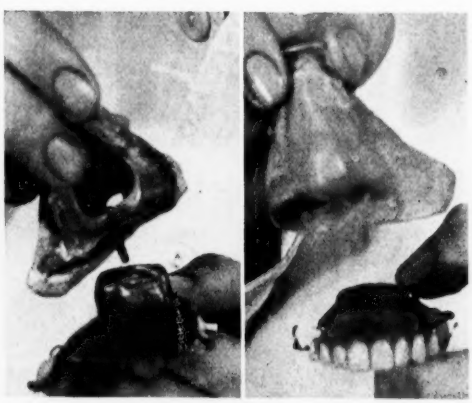


Fig. 15. Case 3.

Fig. 16. Case 3.

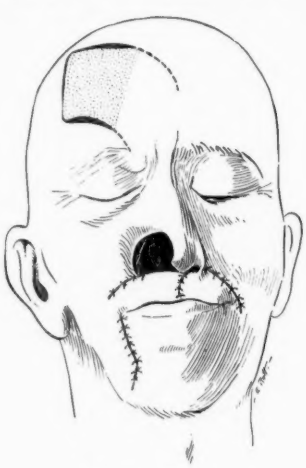
Fig. 17. Case 4.

Fig. 20. Case 4.

ing tissues. The firm retention of the appliance to the face is most important for the comfort and peace of mind of the patient as well as for appearances. To give maximum retention the following methods, either singly or in combination, may be utilized. The base of the artificial nose should rest upon as much tissue as is compatible with its form. There should be a horizontal extension from the base of the appliance to the floor of the nose; this will prevent it from sliding downward. Spectacles are quite frequently used for retention purposes. The bridge and nasal sides of spectacles should fit accurately to the nose in a definite groove, and their greatest pressure should be at the lowest point of contact half way down the side of the appliance. If there is a perforation of the palate to the nasal floor, an attachment should be provided to connect the artificial nose to the upper denture. This feature combined with the use of spectacles and a good fitting base will secure the maximum retention.

Cancers of the upper jaw, hard palate, and maxillary sinuses are usually more responsive to treatment than those of the soft palate, tonsils, tongue, and lower jaw. The most accepted method consists of liberal excision of the cancerous tissue, supplemented by radiation. This naturally results in defects of the palate and maxillary bones, ranging from small perforations to a total destruction of the hard palate, and it may also be combined with the loss of surrounding soft tissues. In such cases, surgical repair is totally dependent upon artificial restoration for its success. Such restorations have three main functions: they cover the palatal defect enabling the patient to speak and to take nor-

Fig. 18. Case 4.



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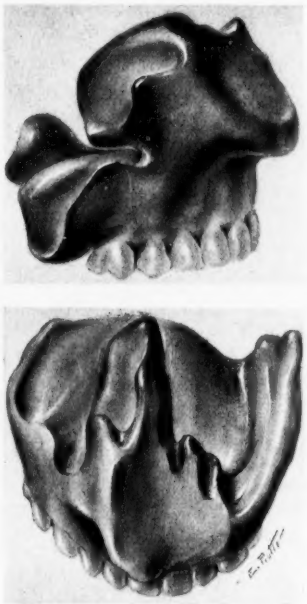

Fig. 21. Case 4.

Fig. 22. Case 4.

mal nourishment; they act as a support to the soft tissues in the absence of bony framework; and they prevent adhesions and cicatrization as previously referred to.

Gross deformities of the mandible, characterized by a definite loss of continuity of the mandibular arch, generally result from osteomyelitis followed by necrosis, trauma including gunshot wounds, or operations for neoplastic diseases. The type of deformity varies a great deal, depending upon the amount of bony tissue destroyed, the presence of sound teeth, the condition of the soft tissues, and the presence of adherent scars causing distortion of the remaining part of the mandible. In treating such cases, our aim is to restore mandibular function for mastication and to minimize the external deformity.

The ideal method of treatment would be to transplant bone in order to fill the gap and restore continuity. This is possible only in cases in which there is only a moderate amount of bony tissue missing. In cases which are not suitable for bone grafting, we are obliged to resort to prosthesis. We must remember that the break in continuity of the mandibular arch should not imply complete loss of function. If we are able to retain the isolated segment of the mandible by a suitable device so that the remaining upper and lower teeth occlude, we can establish a fair degree of masticating power even though part of the bone is missing. Certain types of appliances are designed merely to hold the remaining part in normal position, and they are correctly called retention appliances. In such cases, no attempt is made to correct the external deformity if one is present.

Another type of appliance not only keeps the remaining part of the mandible in its normal position, but also gives fullness to the side of the face where the section of the mandible has been removed. These appliances are truly called artificial jaws as they resemble the missing part of the bone, both in contour and shape. They have limited uses, however, in that they are only practical in patients who have been submitted to resections of the jaw for non-malignant tumors.

The artificial restoration of orbits can be satisfactorily accomplished, as is exemplified among the appended cases. Such an appliance requires a considerable amount of technical skill to construct, but judging from the results we have obtained in the clinics of the Harvard Dental School, it can adequately be handled by a skilled prosthodontist, whether or not he may have had any surgical training. Certain advantages in the use of prosthesis for the restoration of orbits, noses, and ears are extremely important. In cases in which the defect has resulted from the radical treatment of malignancies, it is urgent to keep the adjacent tissues under observation for a considerable period of time in order to discover recurrences. With prosthesis as the basis of restoration, this is much simplified, and in the case of restoring noses, it is generally much to be preferred to plastic surgery.

Congenital cleft palate cases have been treated for many generations by both surgery and pros-

Fig. 23. Case 5.

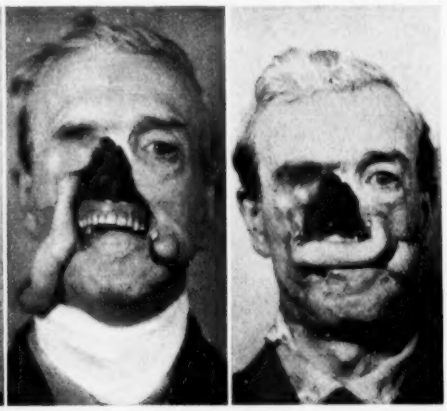

Fig. 24. Case 5.

thesis. Authentic records of the use of prosthetic appliances for defects of the palate resulting from lues and gunshot wounds date back to Ambroise Paré in 1541, followed by Jacques Gullemean fifty years later, Pierre Fauchard in 1728, and many others since. Undoubtedly the discovery by Goodyear in 1855 of vulcanite rubber as a base for dentures and other improvements in the field of prosthetic dentistry served to stimulate further development of appliances for the treatment of cleft palate. Kingsley gives credit to Snell of London for conceiving the idea of constructing an appliance for this type of defect in 1868. Early efforts were somewhat crude as to construction, but the principles laid down by Snell, Suerreson, Kingsley, Case, and others were sound, and whatever changes came later dealt with details of construction rather than fundamentals.

It is an odd coincidence that the first cleft palate operation was performed by a dentist, a Frenchman named Le Mannier, in 1764, but no importance was attached to it until 1825 when Roux, of Paris, and John Warren, of Boston, independently, re-introduced it into the field of surgery. As we all know, there was considerable discussion at one time in the dental literature

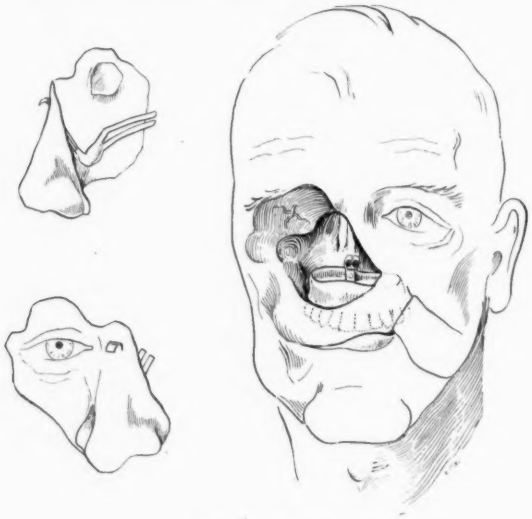

Fig. 25. Case 5.

Fig. 26. Case 5.

bout the value of surgery for the treatment of eft palate as contrasted with artificial appli-nces. Fifty years ago, Kingsley indignantly id: "although the practice has been tested in housands of cases by the most eminent surgeons f their time, it has resulted in such a uniformity f failure, considered as a beneficial operation, hat it should have been utterly abandoned long go." Later Calvin Case and other prosthetic nen voiced the same sentiment only with less severity. Much progress has been made, however, in cleft palate surgery since Kingsley's time. Today we consider the present technique of great value, and it is almost universal to give every cleft palate child the benefit of operative treatment.

Formerly the surgeon was satisfied if the child presented good operative results. The literature on this subject mainly discussed various operative methods and gives pictures of the child before and after operation. Very little was written, however, on the subsequent developmental changes. Now we are not satisfied with the immediate operative result alone. It is the surgeon's duty to keep the patient under constant observation until adult age. Speech defects are quite common and require training.

To the dentist, however, congenital cleft palate is significant for other reasons than from the standpoint of the deformity itself. He is particularly interested in the effect which this condition has on the teeth and general oral health. Almost invariably malocclusion is present, because the cleft produces an insufficiency of masticating surface, leading to the underdevelopment of the maxilla. The dentist regards malocclusion as a serious problem, largely because he recognizes interference with proper growth and development of the jaws and teeth to be an important factor in the incidence of dental disease.

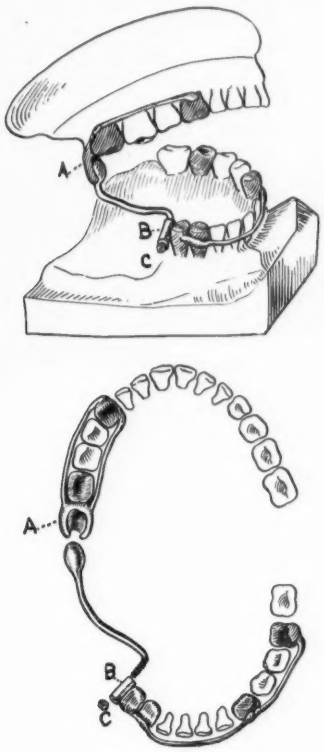


Fig. 27. Case 6.

Steps to correct irregularities of the teeth and to expand the maxillary arch must generally be taken by means of orthodontic appliances for cases of congenital cleft palate, following surgical treatment, and excellent results can frequently be obtained. The orthodontist is particularly trained to undertake this work, and he can contribute a great deal to the alleviation of the deficiency. Often this can be achieved by relatively simple orthodontic means, yet also more extensive measures must be occasionally employed. In complicated cases, in which the maxillary teeth are badly misplaced, we have found it necessary to extract some of these teeth, leaving as many as necessary to provide the foundation for a dental plate which not only covers the deformity but also affords a pleasing appearance in the anterior part of the mouth.

In view of the modern advances in the operative treatment of cleft palate cases, one might think that the construction of artificial palates and obturators might soon become a lost art. This is

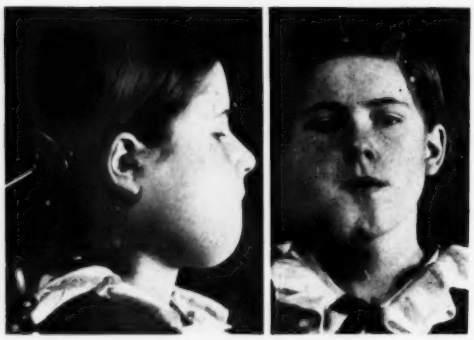

Fig. 28. Case 7.

not so. It is true that obturators are made less frequently, but there are still many patients who arrive at adult life without benefit of surgery and whose appliances may have to be, from time to time, renewed. Moreover, not all operations are successful, and the construction of appliances for such patients often presents more complex mechanical problems than for those who have had no operative treatment. Thus the use of prosthesis for congenital cleft palate cases will probably never disappear.

## CONCLUSIONS

In the foregoing sections, I have attempted to emphasize the need for co-operative effort between medicine and dentistry in the restoration of facial deformities, and particularly to call to the attention of the surgeons, who are most frequently called upon to handle such cases, the benefits available in the dental field. For the type of work which I am constantly facing, this point has been brought home most forcibly to me. It is too much to ask, nor is it at present necessary or desirable, that the dentist or the surgeon be skilled in the other's field. But there is nothing to prevent either from being informed of it, and my great hope is that a real unity of effort will be achieved in the near future—a unity which will bring increased benefits to the patient whose welfare is fundamentally our principal objective.

## CASE REPORTS

Case 1. R. M., aged 19 years. This patient had been operated upon for repair of the palate in early childhood. He had probably one of the most extensive types of adult cleft palate deformities (Fig. 1). Local examination showed the nose distorted toward the right side, due to the deviation of the nasal bones, as well as the displacement of septal and lower lateral cartilage. The upper half of the face including the lip, was markedly retracted, while the lower part of the face looked unduly prominent. The upper teeth were poorly developed and scattered over the palate (Fig. 2). The hard palate had lost its normal contour and was covered mostly by scar tissue, while the soft palate had no uvula and was poorly formed and short. His speech, however, was fair. The treatment of the case involved many interesting points. The following were the most important: (1) correction of the nasal deformity and impaired breathing; (2) correction of the retraction of the upper lip; (3) the reconstruction of the patient's dental apparatus.

Operation, May 17, 1930, Massachusetts Eye and Ear Infirmary. General anæsthesia was used. First, submucous resection of the septum was done. Second, all the teeth of the upper jaw in malposition were extracted, only the molars and bicuspids being left. No effort was made at this time to correct the deformity of the lower part of the nose. In order to correct the retraction of the upper lip it was necessary to free the base of the lip from adhesions and introduce a prosthetic appliance to retain the contour of the lip in its normal position. This temporary appliance was prepared following the first operation.

Operation, July 17, 1930, Massachusetts Eye and Ear Infirmary. General anæsthesia was used. First, a wide incision was made along the buccal fold under the upper lip and, with a blunt instrument, the soft tissues under the nose and the sides of the nose were freely separated from the periosteum (Fig. 3). Second, dental composition was added to the buccal rims of the temporary denture and fitted to the raw area under the lip. Third, a sufficient amount of skin graft was taken from the thigh and pressed firmly against the denuded area, the denture being used as a splint. Fourth, the lip was then repaired by excising the scars and making a better approximation of the uneven borders. The appliance was not disturbed for a few days. By this time the skin graft within the buccal cavity had taken and there was a good space under the upper lip and side of the cheek for a permanent prosthetic restoration. He was discharged from the hospital on July 31, 1930.

October 22, 1930. The third and last operation was performed for the correction of the nasal deformity. It was necessary (1) to correct the nasal deviation; (2) to shorten the nose; (3) to raise the tip; and (4) to correct the dissymmetry of the nostril.

Following his discharge from the hospital a permanent denture was made (Figs. 4 and 5).

Case 2. F. R. This patient reported at the Huntington Memorial Hospital in May, 1930, for advice on a lesion of her nose. Examination showed an ulcerated lesion involving the medial third of the upper lip and borders of the nose. The lower part of the nose and part of the upper lip were destroyed. She was admitted to the hospital.

On June 13, the patient was operated upon for removal of the carcinoma which involved excision of the greater part of the nose, cartilage and septum, and the upper lip. Partial repair of the upper lip was done by utilizing the remaining part on the right side and part of the lower lip on the left.

Two more operations were performed for further plastic repair. In the first operation, the lip was reformed by joining the two flaps and enlarging the mouth by incisions at the right and left angles, while in the second, the borders of the nose were prepared for a better adaptation to an artificial appliance.

Following the patient's discharge from the hospital she reported to the Harvard Dental School where an artificial nose was constructed under the author's direction. She was discharged on October 17, 1930 (Figs. 6 and 7).

Case 3. A. C. A. This patient was admitted to the Massachusetts General Hospital on April 6, 1930, for carcinoma of the face. The disease had its origin 15 years

Fig. 29. Case 7.

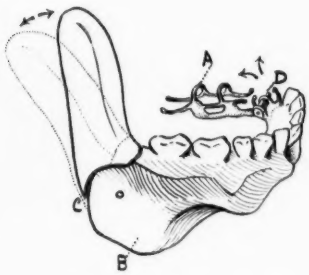


Fig. 30. Case 7.

Fig. 31. Case 7.

eviously starting as a small pimple on the left side of the per lip. It was diagnosed at that time as lupus. Numer- s treatments of X-ray, sun, carbon dioxide, and caustics ere given, but in spite of these treatments, the lesion d continued to grow. Its entire progress had been pain- ss. Aside from the local lesion, the patient was in ex- llent health. Examination on admission to the hospital owed a large ulcerated mass covering the greater part the nose and upper lip, invading the hard palate as well s the internal structure of the nose. The biopsy report was "basal cell carcinoma" (Fig. 8).

On April 23, the patient was operated upon under gen- eral anæsthesia. A wide excision of the cancerous tissue was made by electrocoagulation. Four front teeth were removed as well as the anterior processes and the greater part of the septum of the nose. The entire area was desic- cated with electrocoagulation. The wound was left wide open (Fig. 9).

While the wound was gradually healing, plans were made for the repair of the lip and nose. The following plan was adopted: (1) to perform a plastic operation and repair the upper lip; (2) to restore the nose with prosthesis.

In the next operation the upper lip was repaired by taking a rectangular flap from the right side of the lower lip. This flap included skin as well as mucous membrane. On the left side, the skin of the cheek and side of the face were utilized as seen in the diagrams (Figs. 10, 11, 12). Later, the external perforation of the antrum (as seen in Fig. 13) was closed by undermining the skin tissue of the lower eyelid and side of the face, and bringing it forward to the border of the nasal outline. Previous to the opera- tion on the lip a temporary denture was made in order to retain its proper contour (Fig. 14).

Following the plastic operation a dental and nasal prosthesis of vulcanized rubber was made at the Harvard Dental School. This consisted of an upper denture held in position by clasps. A stout square wire was attached to the anterior part of the denture so as to protrude behind the upper lip into the nasal cavity. An artificial nose was made with an attachment of a square tube at its inner sur- face to fit on the attachment of the denture (Fig. 15).

Rhinoplasty was seriously considered in this case and in fact preliminary steps were taken by preparing a forehead flap, but owing to the uncertainty of a possible recurrence of the disease, it was decided to have the patient continue with the prosthesis, as this method gives a better chance for observation (Fig. 16).

Case 4. W. G., aged 56 years. This patient was operated upon by Dr. Charles Lund in March, 1929, for adeno- carcinoma of the right maxillary sinus, palate, and upper lip. Examination (Fig. 17) showed that the patient had lost part of the right side of the nose, upper lip, and the anterior third of the palate. The mouth was edentulous, and there was an old un-united fracture on the right side of the lower jaw. The wound was free from any suspicion of malignant disease. At this time a vulcanite plate was made to fit over the upper jaw. Prior to plastic operations for the repair of the lip, a temporary upper denture was made which was retained by a finger-like projection of the vulcanite toward the floor of the nose.

Seven operations were performed under local anæsthesia extending from April 28 1929, to January 25, 1930. The lip was repaired first by utilizing the remaining part of the upper lip on the left side, and second by taking a rec- tangular flap from the right side of the lower lip, using the full thickness of the cheek (Figs. 18 and 19). For the repair of the nose, a skin graft was introduced to the under sur- face of a forehead flap; this flap was later brought down to close the nasal defect (Fig. 20).

After leaving the hospital a new dental plate was con- structed to fit the patient's upper jaw, thus making it possible for him to talk distinctly. This appliance, as you will see, is held in position by contact with the nasal tis- sues posteriorly and with the lips anteriorly (Figs. 21, 22).

Case 5. A. B. This patient reported in 1928 for repara- tive treatment. His past history dates back to July, 1918, when a small wart-like growth appeared on the nose. In looking over the history I found that he had radiation as well as operative treatment at various times. The last operation was performed in May, 1928, at the Huntington Memorial Hospital. Examination showed destruction of the right eye and orbital contents, the entire nose, upper lip, and entire hard palate with the exception of the region supporting the left upper third molar tooth. The soft palate was intact, and there was no evidence of a recur- rence at the time of examination (Fig. 23).

The plan adopted for reparative treatment consisted of the following steps: (1) plastic operations for the replace- ment of the upper lip; (2) construction of an upper denture to cover the palatal vault and to support the upper lip as well as the nasal and orbital prosthesis; (3) to restore the nose, orbit, and side of the face with prosthesis.

An attempt was made to utilize the tissues on the right side of the face but I failed, possibly due to the fact that

he had had extensive radium treatment. Subsequently, a tube flap was made on the side of the neck which was gradually transferred to the face as seen in (Fig. 24). The prosthetic appliance consisted of an upper denture with a clasp encircling the upper left molar, and a projection of the denture extending over the border of the soft palate. On the nasal side of the denture, two parallel tubes were inserted on a hinged vertical bar to receive a fork connected with the facial prosthesis. The facial prosthesis as seen in Figure 25 consisted of a combined nose, eye, and side of the face. In addition to the forked attachment mentioned in connection with the dental plate, spectacles were used to hold the prosthesis in position (Fig. 26).

Unfortunately, the patient suffered a recurrence of the malignant disease, but he was able to use the appliance with considerable comfort for a long time.

CASE 6. Mrs. C. This patient was operated upon for adamantinoma of the mandible by Dr. Channing Simmons, in 1930. After the tissues of the mandible were healed she was referred to me for prosthetic restoration.

My examination showed that the right ramus and part of the body of the mandible were missing. While the patient was able to bring the remaining teeth of the mandible into good occlusion, the necessary power for mastication was lacking.

As seen from the diagram (Fig. 27) gold crowns were made for the right upper first bicuspid and second molar teeth, and connected with buccal and palatal wires. At the distal end of the molar crown an extension socket was made, *A*. The lower appliance consisted of a series of crowns over the teeth. A tube was soldered to the distal side of the right lower bicuspid crown, *B*. The connecting link for the upper and lower appliance was made of heavy gold wire, the distal end of which fitted into the groove above, while the lower end was bent at right angles and fitted into the tube below. This was prevented from slipping by a small threaded nut attached to the threaded wire, *C*.

This appliance allowed enough freedom for the lateral motion of the mandible, and at the same time, prevented the mandible from swinging backward. Soon after the appliance was cemented over the teeth, the patient was able to control the mandible more effectively and acquired greater power of mastication.

CASE 7. L. M., aged 16 years. This patient suffered from a rapidly growing tumor of the right side of the mandible (Fig. 28). She gave a history of an operation in January, 1931, for "cyst of the jaw" and another one in April, 1931. In August, she was given radium treatment of approximately 4000 millicurie hours but the tumor continued to grow and she was admitted to the Massachusetts General Hospital in December, 1931. Examination at this time showed a large, apparently encapsulated, hard mass involving the right side of the mandible and extending into the temporal fossa. The general condition of the patient was good.

The patient was operated upon at the Massachusetts General Hospital, removing the entire mass (Fig. 29). After the first 2 weeks during which she was on the danger list, her convalescence was fairly rapid. A few days following the operation, a temporary artificial jaw extending from the temporomandibular joint to the existing teeth on the left side, was introduced in order to keep the normal contour of the face as well as to hold the remaining part of the mandible in its proper position. After she was discharged from the hospital, she reported to the Harvard Dental School where a permanent artificial denture was made under the author's direction.

As seen from the diagram (Fig. 30), the appliance consists of two main sections: first a series of crib clasps fitted over the selected teeth on the left side, *A;* second, a vulcanite plate more or less shaped to the contour of the mandibular bone designed to replace the missing segment, *B*. There are two hinged joints, one at the angle of the artificial ramus, *C*, the other at the junction of the clasps and vulcanite plate, *D*. The purpose of these joints is to give more flexibility to the apparatus and to prevent undue strain on the teeth that are carrying the clasps.

The appliance when first introduced into the mouth, rested upon the raw surfaces of the buccal cavity, but epithelial tissues gradually grew under the appliance. The ideal method would be to do a skin grafting to cover the raw surfaces but for various reasons this has not as yet been done.

The microscopic examination of the tumor showed small round cell sarcoma. Up to the present time, however, there has been no evidence of recurrence although the pathological picture does not give much hope for a final cure (Fig. 31).

Since this paper was written, the patient has unfortunately had a recurrence of the malignancy in the scalp and later in the naso-pharynx. Extensive X-ray therapy does not seem to have had any alleviative effects. The patient was able to use the prosthetic appliance described above comfortably for 2 years. The final diagnosis was endothelioma.

# IRRADIATION OF THE PARATHYROIDS IN GENERALIZED OSTEITIS FIBROSIS CYSTICA[1]

## Report of a Case

MAX CUTLER, M.D., and SEWART E. OWEN, Ph.D., Chicago

THE relationship between generalized cystic disease of the skeletal system and hyperfunction of the parathyroid glands has received much attention in the recent medical literature. The experimental production of the disease in animals by the injection of parathormone, the discovery of patients suffering from multiple cystic bone lesions after parathyroidectomy, and the frequent association of the characteristic bone lesions with hypercalcæmia and parathyroid tumors leave little doubt as to the etiological relationship between hyperfunction of the parathyroid glands and generalized osteitis fibrosis cystica. In 1932, Hellstrom found 32 cases in the literature in which parathyroidectomy had been performed for this state and added one case of his own. Further reports have appeared since this publication.

The purpose of this communication is first to present the clinical result in a case of generalized osteitis fibrosis cystica treated by radiation of the parathyroid glands and, second, to suggest the possible value of radiation as an aid in determining which of the parathyroid glands is responsible for all or the greater part of the hyperfunction.

That radiation treatment of the affected bones has had a beneficial effect upon generalized osteitis fibrosis has been recorded in the literature. Thus Rappaport has reported the case of a young woman aged 28 years. The disease which was generalized had been present 8 years with relapses and remissions. There had been spontaneous fractures. Biopsy of one of the cysts in the tibia showed the histological structure of giant cell tumor. A prolonged course of calcium therapy by mouth and roentgen-ray therapy to the diseased bones extending over a period of 18 months resulted in marked clinical improvement and roentgen examination of the bones showed an increased calcium content in the cystic areas. A patient reported by Schneyer received extensive roentgen-ray therapy to the skeletal lesions and showed marked clinical improvement. The pains disappeared and calcification of the cystic lesions was noted on X-ray examination. A case reported by Gerlach in which intensive roentgen-ray therapy was administered to the diseased bones under an erroneous clinical diagnosis of sarcoma proved at autopsy to be generalized osteitis fibrosis cystica. The irradiated bones showed transformation of the fibrous bone marrow to a solid tissue which exhibited no signs of new bone formation.

Whereas the above observations are examples in which radiation therapy was administered to the affected bones, the present communication is concerned with the effect upon the course of generalized osteitis fibrosis cystica by irradiation of the hyperactive parathyroid glands. A review of the literature indicates only a few recent references upon this phase of the problem.

In 1931, Quick and Hunsberger reported the results of roentgen treatment of a palpable parathyroid tumor in a patient suffering from generalized osteitis fibrosis cystica. The authors state that following removal of the tumor the serum calcium again increased and roentgen irradiation was administered without improvement. They do not state the dosage, consequently it is impossible to interpret the significance of this observation.

In 1932, Hellstrom described the case of a woman aged 54 years whose symptoms began 10 years previously. A tumor of the alveolar process was noted 6 years before admission. Curettage showed a giant cell sarcoma. There was exophthalmus. The basal metabolism was increased and a tumor was present in the region of one parathyroid, the serum calcium was 14 milligrams per 100 cubic centimeters. Roentgen-ray therapy to the parathyroid tumor resulted in a lowering of the basal metabolism, disappearance of the exophthalmus, and a marked clinical improvement. The cystic lesions which were found to be widespread throughout the skeletal system showed healing by calcification. This case is an example of hyperthyroidism and hyperparathyroidism with marked beneficial effect upon the course of the disease following roentgen-ray therapy to the parathyroid tumor. A similar improvement in symptoms following radiation therapy of the parathyroids has been observed by Weil (quoted by Mandl).

In a recent observation recorded by Huguet, the disease was limited to the right radius which showed a typical cystic lesion. The blood calcium was elevated. Roentgen-ray treatments were administered to the parathyroids and ergosterol was given by mouth in large doses. After eight

[1] From the Cancer Research Unit and the Tumor Service, Veterans' Administration Facility, Hines, Illinois. Published with the permission of the medical director of the Veterans' Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the writers.

Fig. 1. Photograph of patient after treatment. November 11, 1933.

Fig. 2. Spine, during treatment. January 5, 1933.

exposures the calcium content of the blood and urine was reduced to normal and the bone lesion showed marked improvement. The ultimate result is not recorded.

In 1932, Merritt reported the case of a white woman, aged 34 years, who, in 1928, developed signs of hyperthyroidism for which subtotal thyroidectomy was performed. One year later symptoms of hyperthyroidism recurred and in addition she complained of stiffness in the right knee. On examination the patient was found to be emaciated, the basal metabolic rate was plus 35 per cent. Calcium determinations were not made. The right knee was swollen and roentgenograms showed cyst-like areas of bone destruction involving the distal end of the femur. No other bone lesions were discovered. The thyroid and parathyroid areas were irradiated. Three weeks later there was noticeable improvement in the patient's condition. Further treatment was given to the thyroid and parathyroid areas. On subsequent examination roentgen-ray studies of the knee showed scarcely a trace of the original bone lesion or of hyperthyroidism. In this patient the bone disease was localized and there is no record of the calcium content of the blood. The clinical result, however, is so striking that the relationship can scarcely be questioned.

CASE REPORT

The patient is a white male, aged 43 years, a farmer by occupation. He was admitted to the Veterans' Administration Facility, Hines, Illinois, on September 18, 1932. The family history was negative for tuberculosis, cancer, diabetes, syphilis, and neuropsychiatric diseases. His past history was negative except for an attack of influenza in 1929. In 1930, following repeated attacks of abdominal pain and vomiting, cholecystectomy and appendectomy were performed, resulting in complete relief of these symptoms.

The patient dates his illness to May, 1927, at which time there was a gradual onset of general weakness and fatigue on exertion. He found that he could no longer carry on his work. This condition was soon followed by severe pains in the right hip, back, neck, and head, and subsequently, the left hip. Two years before admission to this hospital (September, 1930) the patient was hospitalized in another institution where a diagnosis of Paget's disease was made. Following his discharge from the hospital he found he could no longer walk and it was necessary to use crutches. He slowly lost control and use of his legs and in June, 1932, was confined to bed.

Examination upon admission resulted in the following findings: The patient was unable to move the lower extremities and complained of a stinging sensation and numbness in both legs. The numbness extended as high as the lower costal margins. He was poorly nourished and the muscles showed a marked hypotonicity. There was diffuse tenderness throughout the entire skeletal system. The reflexes at the knees and ankles were exaggerated. The

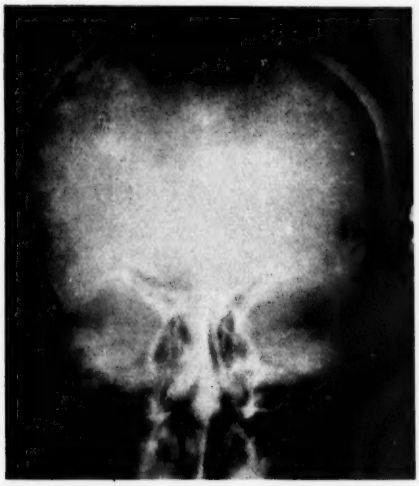

Fig. 3. Skull, anterior view. Before treatment. September 19, 1932.

Fig. 4. Skull, anterior view. After treatment. July 13, 1933.

plantar reflexes were normal. Manipulation of the hip joint caused pain, more marked on the right side, but there was no limitation of motion. There was extensive muscular atrophy. The abdomen was somewhat extended, but no masses could be palpated. Examination of the spine showed an obliteration of the lumbar lordosis and on palpation an irregularity could be felt over the spinous process of the fourth and fifth dorsal vertebræ. There was marked tenderness upon manipulation of the cervical spine.

Neurological examination showed that the pupils were equal in size and reacted normally to light and accommodation. The abdominal and cremasteric reflexes were sluggish. The deep reflexes of the extremities were slightly exaggerated, but equal on the two sides. There was some disturbance of sensation over the lower extremities; however, tactile and tone sensations were not entirely lost. There was marked hypotonia of the lower extremities with marked muscular atrophy, apparently more marked on the right side than on the left.

Examination of the X-ray films revealed the following findings: The bones of the skull showed considerable widening between the inner and the outer tables, the usual trabecular structure of the calvarium was replaced by an irregular, mottled process. The sella turcica was normal. Examination of the long bones showed them all to be involved, the process being most marked in the femora and tibiæ. The changes consisted of widening of the shafts of the bones and obliteration of the trabecular structure,

Fig. 5. Skull, lateral view. Before treatment. September 19, 1932.

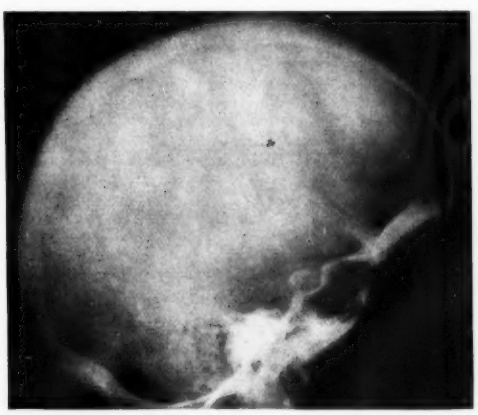

Fig. 6. Skull, lateral view. After treatment. July 13, 1933.

Fig. 7.

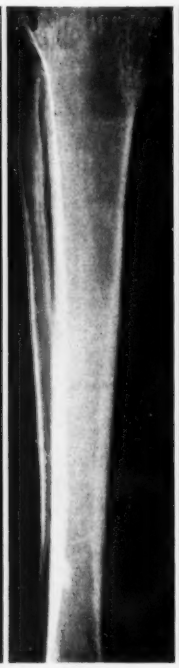

Fig. 8.

Fig. 9.

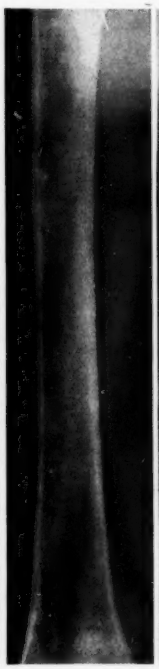

Fig. 10.

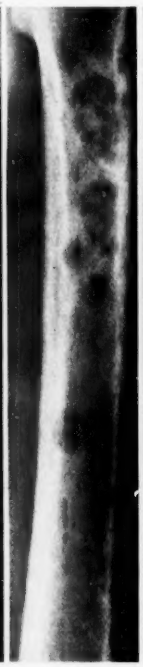

Fig. 11.

Fig. 12.

Fig. 7. Tibia, right. During treatment. January 5, 1933.
Fig. 8. Tibia, right. After treatment. September 6, 1933.
Fig. 9. Femur, right. Before treatment. September 23, 1932.
Fig. 10. Femur, right. After treatment. September 6 1933.
Fig. 11. Femur, left. Before treatment. September 23, 1932.
Fig. 12. Femur, left. After treatment. July 13, 1933.

producing a mottled appearance. Scattered throughout the long bones and skull were numerous cystic areas of bone destruction with clear cut borders varying from 1 centimeter to 5 centimeters in diameter. The posterior portions of the ninth and eleventh ribs on the left, and sixth and eleventh ribs on the right were expanded by irregular cystic areas. There were similar processes in some of the ribs on the right side anteriorly. The dorsal vertebræ showed a diffuse, granular osteoporosis of all the vertebral bodies with a complete collapse of the sixth dorsal vertebra. Pelvic examination showed changes similar to those in the spine with numerous sharply circumscribed cystic areas.

On October 12, 1932, roentgen-ray therapy was instituted over the spine and long bones (see Table I) with no clinical improvement.

Examination of the blood calcium on November 3, 1932, showed 29.4 milligrams per 100 cubic centimeters. Bence-Jones bodies could not be demonstrated in the urine. No tumor could be felt in the thyroid or parathyroid areas. Because of the high blood calcium a diagnosis of hyperparathyroidism and generalized osteitis fibrosis cystica was made and radiation therapy of the parathyroid areas was instituted. Figure 13 indicates the manner in which three fields were irradiated separately and blood calcium determinations made before and after treatment of each field in an effort to determine which parathyroids exhibited the greater hyperfunction.

Figure 14 indicates the blood calcium studies in relation to the time and amount of roentgen-ray therapy. The roentgenograms illustrate the striking bone changes following treatment. Comparison of the roentgenograms before and after irradiation of the parathyroids shows a marked regeneration of bone with an increase in density due to a deposition of lime salts in the cystic lesion. (Figs. 1 to 12.) Many of the cystic areas are no longer discernible and the bones have assumed a normal density. It should be noted that in addition to the roentgen therapy the patient received a high vitamin and high calcium diet.

At the present writing there is a marked and steady improvement in the patient's general condition. Two weeks after treatment of the parathyroids he began to regain the normal use of his legs and the paraplegia has now completely disappeared. His strength has increased so that he is able to walk short distances. The pains have diminished in some areas and disappeared in others; the appetite has improved, and there has been a marked improvement in the tonicity of the muscles.

Attention is directed to a series of observations which indicate that radiation of hyperplastic or adenomatous parathyroid glands associated with generalized osteitis fibrosis cystica and hypercalcæmia results in a lowering of the blood calcium,

TABLE I.—SHOWING X-RAY THERAPY

| Date | Roentgen Units | Area Treated |
|---|---|---|
| 10–12–32 to 11–4–32 | 2349 | Thoracic and lumbar spine. |
| 11–7–32 to 12–5–32 | 1861<br>1003 | Right and left parathyroid area; sternum. |
| 1–31–33 to 2–16–33 | 2081 | Right and left sternum. |
| 4–21–33 to 5–5–33 | 500 | Parathyroids, areas *1*, *2*, and *3* in Fig. 13. |
| 5–22–33 to 6–3–33 | 500 | Right parathyroid area. Area *1* in Fig. 13. |
| 6–12–33 to 6–22–33 | 500 | Left parathyroid area. Area *2* in Fig. 13. |

a calcification of the cystic lesions in bone, and a marked clinical improvement in the patient. Similar and more numerous observations are recorded after parathyroidectomy. The ultimate relative value of radiation and surgery as therapeutic methods will depend upon data which further studies must establish. One of these is the question of permanency of results and many of the treated cases are too recent to be of value in this respect.

It should be pointed out that following removal of parathyroid tumors the blood calcium frequently drops below normal and gradually recovers. In some examples the blood calcium returns to the original abnormally high level. It is possible that in these examples the remaining parathyroid glands gradually take over the function of the diseased gland and ultimately may themselves become hyperplastic and thus overactive. Another possibility that suggests itself is that the adenomatous process may not be limited to one parathyroid gland. One of Hellstrom's cases in which parathyroidectomy failed seemed to indicate the possibility that another parathyroid adenoma was present. It should be noted that an inadequate surgical extirpation may lead to a renewed rise in serum calcium as occurred in the case which Quick and Hunsberger have reported in the literature.

Awaiting further and more prolonged observations upon the surgical and radiation treatment of parathyroid tumors the use of radiation suggests itself under several circumstances: (1) when there are contra-indications to operation; (2) as a postoperative method when an adenoma is only partially removed; (3) when, following removal of one parathyroid adenoma, a persistently high serum calcium suggests the possibility of a hyperplasia or adenoma in the gland on the opposite side.

It is further suggested that exposure to radiation of each parathyroid area separately, protecting the opposite side may constitute a useful method in indicating the site of the adenoma when no tumor can be felt. In our patient a more pronounced lowering of serum calcium occurred on one side than the other. This difference is larger than the percentage of error obtained in the laboratory determination and is, therefore, suggestive.

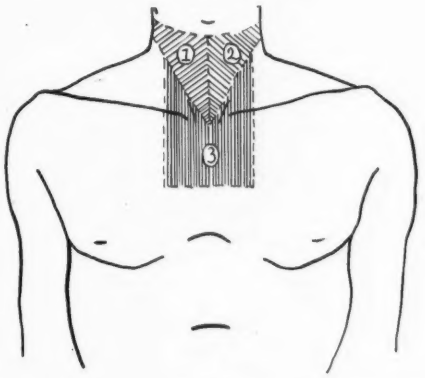


Fig. 13. Showing the areas selectively irradiated. Radiation of areas *1*, *2*, and *3* at once (500r) gave a blood calcium drop from 16.7 to 14.1 or 2.6 milligrams. Radiation of area *1* alone (500r) gave a blood calcium drop of 17.7 to 16.0 or 1.7 milligrams. Radiation of area *2* alone (500r) gave a blood calcium drop of 18.6 to 15.2 or 3.4 milligrams.

This isolated observation is entirely inadequate to permit any conclusions but it is highly suggestive for these reasons. It has been shown experimentally by Walters, Anson, and Ivy that the exposure of the thyroid and parathyroid areas in normal dogs results in a slight hyperplasia of the parathyroids but no increase in blood calcium. It is also known from clinical experience in which huge doses of radium and X-rays are administered over the thyroid and parathyroid areas that the normal parathyroid glands are highly resistant to radiation. Thus, for example, exposure of these areas for the treatment of carcinoma of the thyroid, and carcinoma of the larynx to tremendous doses of radiation does not cause symptoms of tetany.

From radiophysiological studies of other tissues it is known that normal glandular function is highly resistant to radiation whereas actively hyperplastic cellular tissue is more radiosensitive. From these considerations it would be expected that an adenomatous hyperplastic parathyroid gland should respond to radiation by a diminution of its activity whereas a normal gland would respond only slightly or not at all. The response of

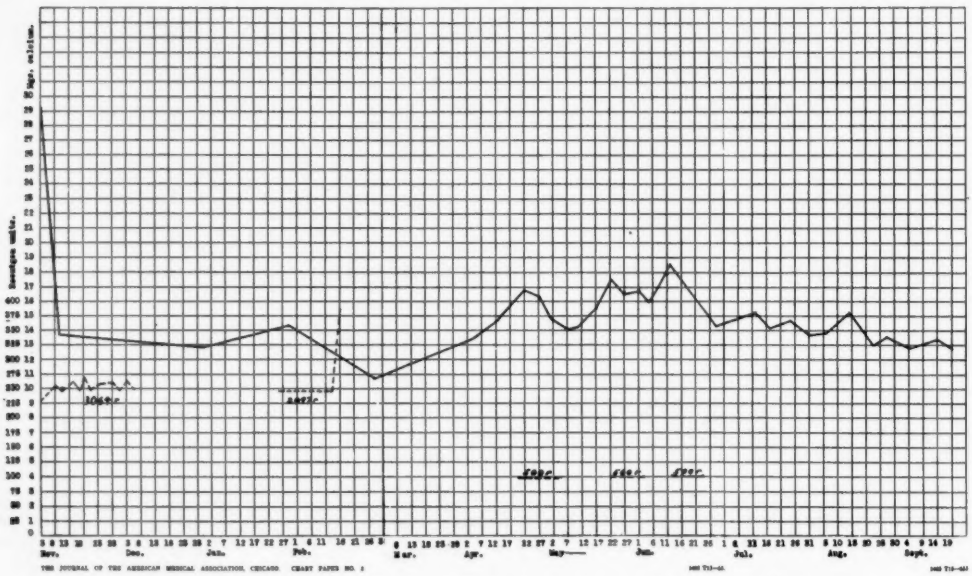

Fig. 14. Blood calcium studies in relation to time and amount of roentgen-ray therapy.

hyperthyroidism to small doses of radiation in contradistinction to the radioresistance of the normal thyroid gland constitutes an important analogy.

## SUMMARY AND CONCLUSIONS

1. A case of generalized osteitis fibrosis cystica associated with hypercalcæmia is reported in which marked clinical improvement took place following treatment by radiation of the parathyroid glands.

2. This observation and others recorded in the literature suggest the use of this method in cases in which surgical operation is contra-indicated or in which parathyroidectomy fails to produce a cure.

3. Radiation of each parathyroid area separately is suggested as a possible aid in determining the site of the adenoma before operation, a procedure which may render the exploration technically less difficult. Further observations along this line are needed.

4. The relative merits of surgery and radiation as the essential treatment of parathyroid adenoma associated with generalized osteitis fibrosis cystica must await further observations.

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# JUXTA-ARTICULAR PARTIAL TIBIAL OSTEOTOMY[1]

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THE occurrence at the knee joint of deformities sufficiently severe to require surgical intervention is so commonplace that, frequently, no more than casual consideration is accorded them. Simple as they may appear to be, there are many which present real problems in reconstructive surgery, and, rather than a facile surgical technique, demand a sound, mechanical philosophy, not of the joint alone, but of the leg as a whole. In many cases the traditional use of supracondylar osteotomy has led to satisfactory results, while in others, to the chagrin of the attending surgeon, the outcome has left much to be desired, though the cases were apparently identical. If these cases are more carefully reviewed, it will be seen that the good results have been noted in those in which relatively normal relationships have been restored and where, consequently, the correction has coincided with the site of the deformity. In the unsuccessful cases, on the contrary, it will be observed that instead of "correcting" it at its site of occurrence, the original angular deformity has been "compensated" by the development of an opposite angulation. Within the limits to which this compensation has been accurately gauged, the development of a scoliotic or cork-screw type of curve may appear to realine the leg beneath its covering of muscles, without, however, obviating the ill effects upon the intervening joints of the stresses and strains to which a leg thus doubly deformed must be subjected.

In those accustomed to locomotion over level ground, it will be observed that the body weight passes approximately through the center of the head of the tibia and that both the superior and inferior articular surfaces of the tibia are approximately perpendicular to the shaft and parallel to each other and the ground (Fig. 1). It must be obvious that a change in any of the component parts of the leg, considered as a column of force transmitting the body weight, must necessarily be associated with the development of correlative signs or symptoms. In the condition of flat feet, the appearance of calf, thigh, or back pain, as symptoms of strain, is common, while in the postoperative care of patients in whom a femoral bifurcation has been performed, a definite tendency toward knock-knee and varus of the foot has been observed. In a quite similar manner, and from whatever cause, any variation, beyond the physiological, in the inclination of its articular surfaces to the shaft of the tibia will determine the appearance either of symptoms or signs directly attributable to that variation. The occurrence of arthritis at the tarsal joint after improperly reduced fractures about the ankle, as well as the appearance of symptoms in the knee joint in association with pes varum or valgum are well known. Probably equally well recognized but less commonly alluded to, are the deformities of the feet which arise as a result of lateral deformities about the knee joint. In the effort to maintain the foot flat upon the ground in walking, either a pes varus or valgus may be noted, though in general genu valgum tends to be combined with a pes varus, while genu varum tends to a pes valgus.

In the lower tibial articulation, the importance of maintaining its perpendicular relation to the shaft of the tibia, even if need be at the expense of a transpositional deformity, has been recognized and emphasized in the treatment of fractures about the ankle. In the upper tibial articulation no such stress has been laid upon the necessity of restoring its relation to the shaft of the tibia and cases have all too frequently been grouped as genu this or that and submitted to routine supracondylar osteotomy, without an attempt being made to analyze the underlying mechanics. In malalinement of the lower tibial articulation, the effort at restoration is directed to the site of deviation. In an identical condition at the upper tibial articulation, supracondylar osteotomy is often performed, though it must be perfectly clear that no amount of correction elsewhere than at the site of angulation can alter the intrinsic relationships of the shaft to the surfaces of the tibia. As a consequence, the operative results in such cases, frequently inconsistent, have seldom been orthopedic in the literal sense of the word.

If non-torsional deformities at the knee joint are considered, it will be seen that, mechanically, only three types are possible; those in which either the femur or the tibia alone is malalined and those in which both bones contribute in varying degree to the appearance of the deformity. In the first, where only the femur is angulated or curved, supracondylar osteotomy at the site of the maximum deviation must obviously lead to a satisfactory result. In the second, where the tibia is the site of angulation, only tibial osteotomy can result in cure, while in the third osteotomy first of

[1] From the service of Dr. Harry Finkelstein, at the Hospital for Joint Diseases.

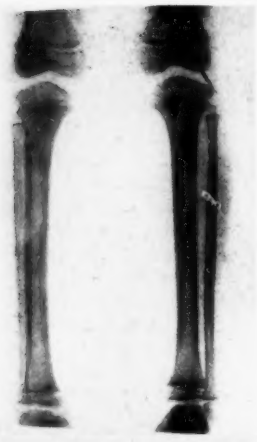


Fig. 1. Note approximate parallelism of superior and inferior tibial articulations, both of which are approximately perpendicular to the longitudinal axis of the shaft.

one bone and then of the other is necessary before cure can be expected. The validity of these contentions will be readily recognized, if the principle of correction at the site of deformity be admitted.

Regardless of whether, clinically, the condition be a valgum, a varum, or a recurvatum, the site of deviation must first be determined before undertaking any type of operative correction. This can be adequately done only by X-rays taken so that the whole tibia or the whole femur, or, where possible, both be exposed upon a single plate. When such plates are compared with the normal (Fig. 1), it will be seen that in type 1 cases the tibial articulations are relatively parallel, while in types 2 and 3 they are convergent. In the varum cases, because of the downward and inward inclination of superior tibial surface in relation to the longitudinal axis of the tibia, the articular planes converge medially. In the valgum cases, tibial surface tilts downward and outward and the articular planes converge laterally, while in the recurvatum cases, the downward and forward angulation of this surface leads to convergence anteriorly. In all of these cases the abnormal angulation of the upper tibial surface in relation to the shaft is characteristic of the clinical picture and is the determining feature in the development of the deformity. It is in these types of cases that corrective juxta-articular partial tibial osteotomy, in preference to compensatory supracondylar femoral osteotomy, is to be used, as the following cases demonstrate.

### GENU VARUM DUE TO DEPRESSED FRACTURE OF THE INTERNAL TIBIAL CONDYLE

Case 1. R. S., female, aged 22 years, gave a history of having injured her left leg when she jumped from a tree. Though not able perfectly to state what happened, the patient believes she suffered a fracture of the tibial condyle and of the fibula. This was apparently set and healed, but one year later, because of the presence of a marked bowing, the bone was again fractured and reset. After the second operation the patient wore a lateral bar brace for over a year and has since then received no treatment. She was first seen in the early part of 1926, complaining of pain in the knee joint on walking, as well as dissatisfaction with the appearance of her bow leg.

There was no limitation of motion whatsoever in the knee joint. There was a moderate degree of bilateral bow leg, more marked on the left. The X-ray showed an old fracture, involving the upper epiphysis of the medial condyle of the left tibia, with an old fracture of the upper end of the shaft of the fibula. There was marked depression of the inner half of the articular surface of the condyle (Fig. 2). On February 18, 1926, under general anæsthesia and a tourniquet, a simple linear osteotomy was made about halfway through the upper portion of the left tibia and the medial condyle was levered upward. A longitudinal wedge shaped piece of bone was then removed from the shaft of the tibia and inserted into the gap formed by levering the medial condyle upward and the shaft outward. The wound was closed in the usual manner and a plaster-of-paris cast applied from the toes to the middle of the femur. Subsequent X-rays showed that the medial condyle had not been sufficiently elevated and the cast was consequently wedged, so as to produce complete alinement of the femur and tibia. At the end of 6 weeks the cast was removed and physiotherapy begun. Since that time the patient has been repeatedly seen and has apparently been completely relieved both of her pains on walking and the psychogenic disturbances which she attributed to the deformity of the leg. Indeed, the leg operated upon is now straighter than her right leg, which apparently suffered no injury whatsoever (Fig. 3).

### GENU VALGUM DUE TO PARTIAL SYNCHONDROSIS OF TIBIAL EPIPHYSIS

Case 2. H. K., male, aged 9½ years, was seen in the Out-Patient Department in the middle of 1927, with a history of having been run over the leg by a truck. Because of the compound fracture and the extent and severity of soft tissue injury, immediate amputation was advised at one of the city hospitals to which the child was taken. The parents objected to this procedure and subsequently the patient was removed to another hospital, where, after several months of care, the wounds finally healed. When seen at our hospital the knee was in severe valgus, with abnormal mobility in all directions. It was felt that conservative treatment was best indicated and a brace was consequently ordered and the patient observed for several months. On May 15, 1928, the boy was again admitted to the hospital. Osteotomy of both tibia and fibula was performed for the correction of a knock-knee deformity. The deformity was apparently corrected and the patient was discharged on June 15, 1928. However, it appears that several months later the correction did not appear to be satisfactory, since the patient was again admitted on December 18, 1928, for the performance of a supracondylar osteotomy of the femur. On January 13, 1929, he was discharged. On June 23, 1930, the patient was submitted to a tenotomy of the Achilles tendon to correct a pes equinus

Fig. 2A.

Fig. 2B.

Fig. 3A.

Fig. 3B.

Fig. 2. Photograph showing bowing of the left leg, with roentgenogram showing depression of the inner half of the tibial condyle; downward and inward tilting of the superior tibial articulation in relation to the shaft of the tibia.

Fig. 3. The same patient, showing result following operation.

On March 23, 1931, he was again admitted to the hospital, walking with a marked limp to the left, the left ilium being lower than the right. There was still abnormal mobility of the knee joint in all directions, with ten degrees of internal rotation of the foot. The measurements were: left ankle, 27½ inches; right ankle, 29 inches; left tibia, 11 inches; right, 12¼ inches; left fibula, 11¼ inches; right, 12½ inches. The angle of greatest extension at the knee was 170 degrees, the angle of greatest flexion 85 degrees. There was a severe genu valgum, with external bowing of the femur. The foot presented a moderate varus of the heel, with adduction of the forefoot. There was a definite scoliosis to the left. The X-ray film showed a lateral bowing of the femur at the site of the previous osteotomy and marked retardation of growth in the external half of the upper tibial epiphysis. The lateral condyle was definitely irregular and depressed below the level of the head of the fibula (Fig. 4).

It was felt that the only satisfactory procedure in this case would involve the raising of the articular surface of the lateral condyle to its normal position above the head of the fibula. Consequently, on March 26, 1931, a longitudinal incision was made over the superior tibiofibula articulation and the lateral condyle of the tibia was exposed. With a broad osteotome, the lateral half of the tibia was cut through and the external tibial condyle definitely levered upward, so that it came to lie above the upper edge of the fibula. A longitudinal wedge from the shaft of the bone was thereupon removed and placed in the osteotomy wound. In an attempt to supply a force which might tend to push the lateral condyle upward as growth of the internal portion of the epiphyseal line took place, the head of the fibula was split longitudinally and bifurcated, so that the medial portion came to lie against the inferior surface of the lateral condyle. The wound was thereupon closed in the usual manner and a plaster-of-paris cast applied from the toes to the mid-thigh. Subsequent X-ray pictures showed that not quite complete correction had been obtained, and it was then realized that the cause for the failure was to be sought in our neglect in releasing the long fibular collateral ligament which bound the head of the fibula to the condyle of the femur, and so prevented correction.

In July, 1933, after preliminary isolation of the peroneal nerve, the operation described was again performed, with this modification: the long external fibular collateral ligament was first detached from its insertion into the head of the fibula and re-inserted into the outer surface of the tibial condyle, to maintain the stability of the knee joint. Osteotomy of the external tibial condyle now permitted slight overcorrection of the plane of the articular surface in relation to the shaft of the tibia, with elevation of the condyle in relation to the head of the fibula. In August, after fairly firm union of the tibial osteotomy had taken place, a Grattan osteoclasis of the femur, for the correction of the femoral bowing, was undertaken. Patient discharged in October, walking with leg corrected for first time (Fig. 5).

It will be noted that marked improvement in the spinal curvature has already taken place. The compensatory varus of the foot is still present, but it is hoped that weight bearing within a relatively normal line of force will result in a gradual correction, without the remodelling operation upon the foot, which will otherwise be necessary. Because of the fact that the inner half of the tibial epiphysis still retains the power of growth which has been lost in the outer half, this patient may again develop a valgum deformity. In that event, re-operation will probably again be indicated.

### GENU VARUM, PROBABLY DUE TO A RACHITIS

CASE 3. G. P., male, aged 1½ years, was admitted to the hospital with a complaint of bow legs. The mother stated that the child had been a full term, normally delivered

Fig. 4A.

Fig. 4B.

Fig. 4. Note downward tilting of the pelvis to the left, with scoliosis to the same side, outward bowing of the left femur, abduction of the left leg, with genu valgum at the knee, marked scarring of the left leg, varus and equinus of the left foot. X-ray film shows downward and outward tilting of the superior tibial articulation, with relative elevation of the head of the fibula above its normal level.

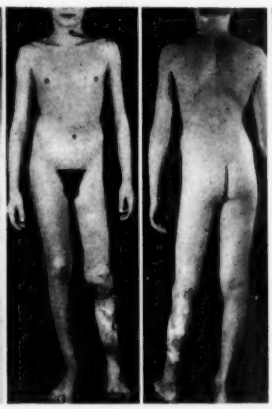


Fig. 5A.

Fig. 5B.

Fig. 5. After operation and removal of cast. Note improvement in curvature of back, alinement of lower extremities and tendency toward correction of foot deformity.

baby, who at the termination of nursing had been fed on a formula fortified by the addition of cod liver oil and orange juice. The baby had developed normally and had begun to walk at the age of 6 months. At the age of 1 year the child had measles and chicken-pox.

On admission the child was apparently normal, but for the legs, which showed a typical O shaped bowing. This appeared to be partly due to a deformity in the lower end of the femur, but more to an angulation just below the inner condyle of the tibia. At this point there was a definite depression, which is easily seen, both on the photograph and on the X-ray (Fig. 6). It will be noted that in addition to a slight curvature of the femur above the joint line, there is marked downward and inward inclination of the superior tibial surface in relation to the shaft of the tibia, so that the upper and lower articular planes tend to converge on the medial side of the leg.

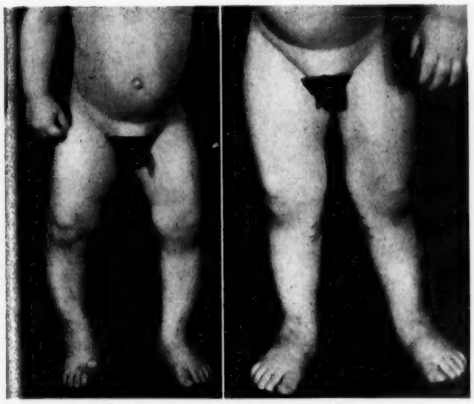
On August 31, 1933, the child was operated upon under general anæsthesia. A simple linear osteotomy of the inner half of each tibial condyle was made and the shaft of the tibia levered outward until the head of the tibia was approximately perpendicular to the longitudinal axis of the bone. A small graft of bone was then removed from the lower portion of the shaft and inserted into the wedge, which had been opened. Plaster-of-paris bandages were then applied in the usual manner. Apart from a slight alinement by wedging of the cast, the convalescence was uneventful. When seen in October, the child was clinically well. The depression on the side of the leg had disappeared. The X-ray showed that the tibial surfaces were relatively normally alined to each other and to the shaft of the tibia. There was still slight bowing of femur, not of sufficient degree to warrant operation at the present time (Fig. 7).

## GENU RECURVATUM PROBABLY DUE TO IMPACTED FRACTURE

Case 4. A. O., male, aged 15 years, was seen in the Out-Patient Department in February, 1933, with a complaint of gradually progressing "back-knee," which had been noted by the mother. The boy originally came under observation in April of 1929. At this time he presented the picture of a typical Froehlich's syndrome. In addition, he was suffering from an epiphyseolysis of the right hip, for which he received treatment by means of a plaster-of-paris spica and subsequently by means of a walking hip brace, which was worn for a period of 2½ years. When the brace was removed, the limp and the limitation of abduction and internal and external rotation at the hip, which had previously been noted, had completely disappeared. For about 6 months the child was apparently entirely well, when the mother noted a progressive backward sagging of the knee. There was no history of trauma, and, apart from the deformity, no symptoms, either of pain or disability.

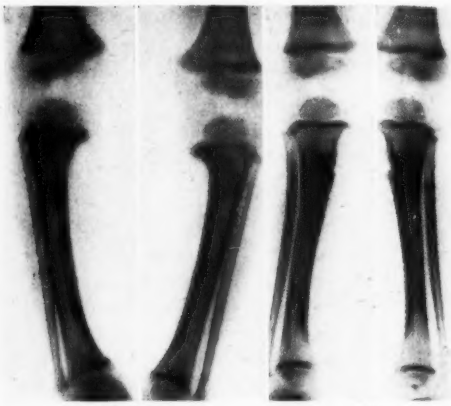
On admission to the hospital, the child was noted to have the characteristic obesity, pubic hair line, etc., of the "fat boy." The right hip was normal in all ranges of motion. The right knee showed a marked prominence of the patella and the femoral condyles. There was a definite recurvatum and a corresponding increase in the range of extension at the knee to 195 degrees. The X-ray showed a marked forward and downward tilting of the superior articular surface of the tibia. Below the epiphyseal line, between it and the apophysis of the tibial tubercle, there appeared to be a definite infraction of the cancellous tissue of the tibia. Instead of a prominence, there was a definite depression at the site of the tibial tubercle (Fig. 8). Whether this represented an impacted fracture at this site or an endocrine disturbance of apophyseal growth, similar to that of the femoral capital epiphysis, cannot be stated, and for the purpose of this communication, is immaterial. It may, however, be noted in passing that in August following his discharge from the hospital, the patient stumbled and suffered a barely discernible fissure fracture of the internal malleolus of the same leg.

Whatever the underlying etiology, it was recognized that the basic indication was for restoration of the normal relationship between the plane of the articular surface and the longitudinal axis of the shaft of this tibia. Ideally, the osteotomy should have been performed at the area of de-



Before. After.

Fig. 6. Typical O shaped genu varum. Note marked medial convergence of tibial articulations. Left, before; right, after correction.



Before. After.

Fig. 7. Same patient as in Figure 6. Note that after correction the tibial articulations were parallel with an S shaped curve in the shaft of the tibia.

pression below the tibial epiphysis, but, because of the attachment of the patellar tendon, this would have been impossible without preliminary transplantation of the insertion of the tendon. This, naturally, was not considered, and in March, 1933, a simple, oblique osteotomy of the tibia was performed through an external incision, after careful isolation of the peroneal nerve. The plane of the incision extended from below the tibial tubercle, backward and upward into both condyles.

With the patellar ligament acting as an internal fixation for the upper fragment, the lower portion of the shaft of the tibia was easily levered away from the osteotomized fragment, until fluoroscopic examination established the correction of the inclination of the articular surface. The wedge thus opened was maintained by the insertion of a small bone graft and the leg was enclosed in plaster-of-paris, with the knee in flexion. When the X-ray demonstrated bony union, the cast was removed and exercises were instituted for the restoration of power in the muscles of the leg. By July the boy was discharged with normal function and with no evidence of any residual recurvatum (Fig. 9).

The 4 cases, here reported, were chosen as typical examples indicating the treatment of angular deformities about the knee joint. Whatever its significance may be as to prognosis, the underlying etiology of the condition plays no part in determining the operative indication. This is clearly a restoration to the normal by correction of the deformity. The decision as to the best site for operation can be arrived at only by careful study of the X-ray of the whole leg. The crux of the problem is the relationship of the tibial articular surfaces to each other and to the shaft. Provided the articular planes are normally parallel, supracondylar osteotomy is indicated, but when this is not the case, operation elsewhere than at the site of deformity is doomed at the outset to mediocre result, or, still worse, to failure. When the underlying causes may be overcome, as in rachitis, or when they have ceased to act, as in the fracture cases, a single correction of the resultant mechanical defect may lead to permanent cure. But if, as in the case of partial synchondrosis in a still growing child, the cause cannot be eradicated until growth has ceased, the prospect of re-operation at properly timed intervals must be entertained. However, this prospect is not as gloomy as it would at first sight appear, since it permits of repeated re-alinement of the bones and the re-establishment of a relatively normal line of force, with avoidance of abnormal stresses and consequent compensatory changes in all parts of the column of force.

The procedure is simple and apparently rational. The osteotomy is best performed at or above the level of the head of the fibula, so that the relation of the shaft to the head of the tibia can be altered without the necessity of fracturing the fibula. In growing children the line of osteotomy should, of course, be below the epiphyseal line, so as to avoid injury to that structure. In older individuals the line of incision may be nearer the joint surface, but always below the line of attachment of the capsule or the large extrinsic ligaments, which act as the stabilizing forces upon the short, condylar fragment at the time of the maneuver of levering the shaft into proper alinement.

Preferably, the inner side of the tibia is chosen as the site of osteotomy to prevent injury to the peroneal nerve. In cases of varus, a simple, partial osteotomy, with the opening of a wedge,

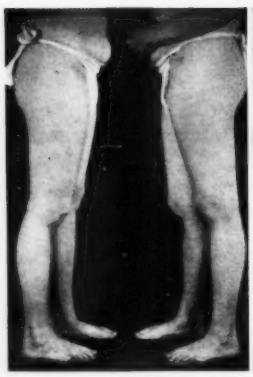


Fig. 8.

Fig. 9.

Fig. 8. Right back knee. Note downward and forward inclination of tibial articulation.

Fig. 9. Same patient after operation. Note the superior tibial articulation now bears normal relation to the shaft of the bone and that an attempt has been made at restoration of the normal prominence of the tibial tubercle.

suffices. In cases of valgus, the removal of a wedge of bone, with internal angulation of the lower fragment, is all that is necessary, provided the head of the fibula is in normal relationship to the outer and under surface of the external tibial condyle. Where this is not true, as in Case 2, reported, the operation must be performed upon the outer condyle, after preliminary release of the external fibular ligament, which otherwise maintains the relation of the head of the fibula to the external femoral condyle, and so prevents correction. Ordinarily, the osteotomy need not be completely across the bone. Except in the most severe angulation, cutting of half, or at most two-thirds of the bone readily permits of green-stick fracture of the other portion and correction of the deformity.

Apart from the fact that it is designed to meet a mechanical problem, at what is mechanically the optimum site, the procedure seems to have several other desiderata and at least one serious drawback. Because the tibia is not completely osteotomized, the likelihood of non-union or of undesired displacements, due to muscle pull, is obviated. Because of the possibility of accurately choosing the site of osteotomy, the danger of injury to the epiphysis or to the ligamentous structures about the joint is avoided. On the other hand, by the very nature of the operation, the elimination of torsional deformities is precluded. For such cases, where marked torsion of the leg is associated with convergence of the tibial surfaces, complete section of the bone is necessary before correction can be obtained.

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## PRE-OPERATIVE PREPARATION OF THE DILATED STOMACH

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IN many cases of pyloric obstruction due to ulcer or malignancy, the stomach may show a marked degree of dilatation. The muscle tone of such stomachs is much reduced, and they hang in the abdomen like a bag filled with stagnant liquid, food particles, and tenacious mucus.

As a general surgical principle, it is unwise to do extensive operations upon any acutely distended portion of the gastro-intestinal tract. When the stomach or bowel wall is overstretched by distention the tone is not only lost but the blood supply is disturbed. Such a viscus may not heal normally and restoration of function is likely to be delayed. To restore the tone and blood supply is, therefore, much to be desired before operation.

A markedly dilated stomach may be restored to normal size in an average of 4 to 6 days by using the continuous gastric lavage with suction.

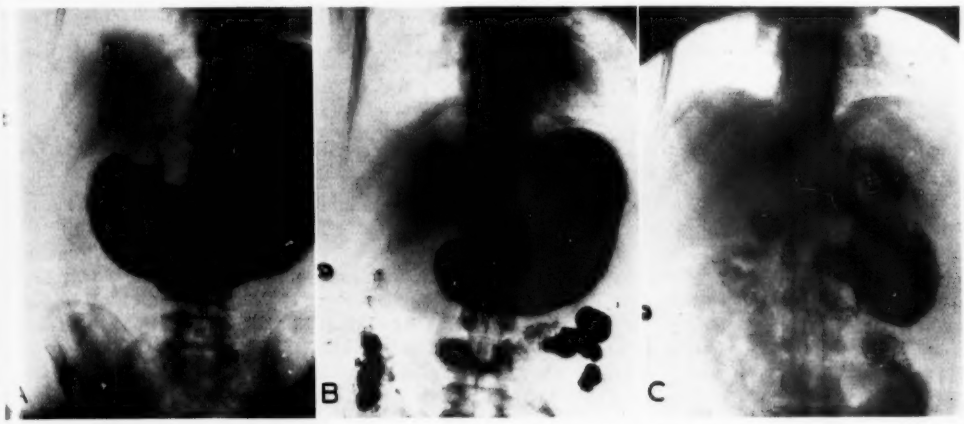


Fig. 1. A. Dilated stomach due to pyloric obstruction. B. Stomach reduced to normal size after lavage. Barium has passed through pylorus. C. Stomach after gastro-enterostomy.

An in-dwelling Levine tube passed through the nose is suitable for this purpose. At the beginning of such treatment, it may be necessary to lavage the stomach through a large tube to remove particles of food and mucus too large to pass through a Levine tube. With the nasal tube in place, the patient is urged to drink as much water as possible. All water, secretions, and gas are promptly removed from the stomach by continuous suction. After a few hours lavage, liquid will frequently begin to pass through a previously completely obstructed pylorus. This may be demonstrated by the administration of a small quantity of barium solution.

During continuous lavage, careful attention must be given to maintenance of chemical, water, and metabolic balance. Before the treatment is started, a study of the blood chemistry may indicate the need of sodium chloride. Water, salt, and glucose should be given by vein or hypodermoclysis. Since a loss of the gastric juice reduces the body chlorides, a daily check of the blood chloride content is advisable.

Figure 1 illustrates a widely dilated stomach which was reduced to normal dimensions after 10 days' treatment. This patient developed complete pyloric obstruction due to a carcinoma. During the continuous lavage suction treatment, several transfusions were given in addition to the daily administration of glucose sodium chloride solution by vein and physiological salt solution by hypodermoclysis. After the tone of the stomach was reduced to normal, a gastro-enterostomy was done and recovery was not accompanied by any complications.

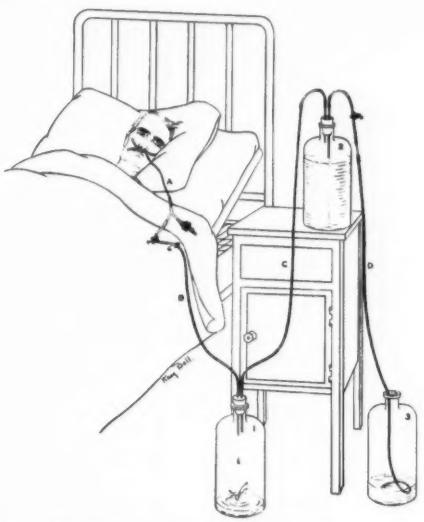

Fig. 2. Suction apparatus used for continuous gastric lavage. This is a modification of methods recommended by Ward and later by Wangensteen. Bottles *2* and *3* are interchangeable. When the high bottle *2* is empty and the low bottle *3* is full, the two are reversed by transferring the rubber cork. Tube *D* is kept full of water with its lower end immersed in water at the bottom of bottle *3*.

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1. WANGENSTEEN, O. H., and PAINE, J. R. Nasal catheter suction-siphonage: Its uses and the technic of its employment. Minnesota Med., 1933, xvi, 96.
2. WARD, R. An apparatus for continuous gastric or duodenal lavage. J. Am. M. Ass., 1925, lxxxiv, 1114.

# SPINAL ANÆSTHESIA IN FACT AND FANCY

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A SIMPLE surgical procedure attracts attention when conducted with an imposing ritual. A dangerous method is accepted with confidence when given a talisman to imply safety. Pin the medal of St. Francis to a questionable technique and its dangers are ignored until brought home by bitter experience. Thus it has been with spinal anæsthesia.

By various innovations, spinal anæsthesia has repeatedly been revived from dark days when it was distrusted and feared into the light of wide acceptance and laudation. A new drug, the dehydration or other modification of an old drug, a dash of strychnine, caffeine, or epinephrine in the ampule as a stimulant, or a fraction of sugar, gelatin, serum, starch, alcohol to imply controllability, have been amulets that repeatedly have restored confidence to a more or less discredited procedure. Again, a position of the patient or the tilt of the operating table, a new name for an old drug, a modification of the needle or method of injection, or the coincident use of special stimulant has been a symbol of safety.

But by none of these measures has spinal anæsthesia been made fool-proof, controllable, or even safe, when used carelessly and indiscriminately. No solution or technical innovation has displaced the necessity for an accurate technique and rigid supervision. The dangers of spinal anæsthesia remain largely with the user rather than the drug or technique employed. Spinal anæsthesia is a most valuable method and its ill effects represent blunders from its improper use. Many conflicting opinions on the subject are spread through the literature to the confusion of the student, and not a few are due to misleading laboratory observations. In the experimental laboratory, working with lower animals, it is difficult for the highly trained comparative physiologist to avoid error. Hundreds of dogs have been sacrificed to disprove what may easily be demonstrated by careful observations made upon the patient under spinal anæsthesia. We read that the puncture of the spinal cord by the needle is fatal, that intradural valves are present that increase the intraspinal pressure in some mysterious way toward the head, that death from spinal anæsthesia never occurs from asphyxia, that the depression of spinal anæsthesia is a condition of shock, that a primary depression and dilation of the heart causes the fall in blood pressure, that the toxic effects are due predominantly not to a direct effect on the cord or spinal roots but to the absorption of the drug by the blood vessels by which only it is carried to and depresses the centers of circulation. Take, for example, the widely quoted experiments of Spielmeyer of 25 years ago indicating that the injection of stovaine into the dura produces a very serious degeneration of the dogs' spinal cord. At the time we had these experiments repeated and learned that in dogs such injections were followed by a permanent paraplegia. But no paraplegia followed 15,000 injections of stovaine in man. The reason is a technical and an anatomical one. The spinal cord in the dog so largely fills the dural space and the spinous processes so overlap that it is difficult to enter the cavity of the arachnoid or to withdraw more than a few drops of spinal fluid without puncturing the cord, whereas in man there is a large spinal cavity, easily entered, from which 30 to 45 cubic centimeters of spinal fluid may readily be withdrawn. Even with the dura exposed by a laminectomy, the experimenter will often inadvertently inject or damage the dog's cord with his needle. Besides this, the dilution and diffusion of the drug, which plays such an important part in the clinical application of spinal anæsthesia, cannot adequately be reproduced in the lower animal. In Spielmeyer's experiments the undiluted stovaine solution, a protoplasmic poison, accidentally entered the cord. In contrast, secondary symptoms from degeneration of the cord apparently never occur when the injection is properly given in man, even though the injections are made above the level of the cauda equina. As many as twelve injections of stovaine, given to one patient for repeated operations, were followed by no evidence of spinal injury. It is to be hoped that future writers on the subject will not continue to repeat the errors of Spielmeyer which apply even less to the mildly toxic procaine[1] now in general use. Quite different is the selective degenerative action on the cord from the injection of a drug like methyl alcohol. We have seen two patients who had permanent localized spinal palsies from the injection of a spinal anæsthetic solution contaminated by a small quantity of wood alcohol.

[1] Procaine hydrochloride U.S.P. (Para-aminobenzoyl-diethylaminoethanol hydrochloride) also sold under various trade names as Novocain, Neocaine, etc.

To prove the safety of high spinal anæsthesia, experiments have been described indicating that procaine, injected within the arachnoid, does not produce respiratory or other type of motor paralysis. Some of the earliest experiments with spinal anæsthetic solutions showed that when these were dropped upon the exposed upper cord or medulla the respirations of the animal promptly ceased, but if artificial respiration was used until the effect of the drug had passed off the respiratory function would return—otherwise the animal would die of asphyxia. Such experiments showing motor paralysis have been repeated many times and are confirmed by thousands of clinical observations. We have seen in the clinic, several instances of primary respiratory failure from the high effect of the spinal anæsthetic, the voice fading to a whisper and disappearing as the air currents ceased, although the heart continued to beat. At least 3 such patients were saved by timely artificial respiration. Other experiments are advanced to prove that the motor paralysis is not due to a block of the posterior nerve roots, which are considered to be immune to the spinal anæsthetic, but to a break in the reflex arc from the anæsthetized posterior nerve roots. The explanation of these conflicting observations lies in the fact that the posterior nerve roots are more susceptible to procaine than the anterior or motor roots. From dilute or weak solutions of procaine we have repeatedly seen a perfect analgesia with retained motor power, indicating that the block of the posterior roots does not reflexly cause muscular relaxation. From more concentrated solutions of procaine a block of the anterior nerve roots with temporary muscular relaxation and paralysis is observed. The experiments of Johnson and Henderson indicate that in the dog, concentrations of ½ to 1 per cent of procaine are sufficient to block the posterior roots and thus interrupt pain producing impulses, while 2½ per cent is required to block the posterior roots and suppress motor impulses.[1] If these percentages are applicable in the clinic, which to some degree seems probable, 120 milligrams of procaine dissolved in but 6 cubic centimeters of cerebrospinal fluid would have a concentration too weak to cause motor palsy. Because motor, including respiratory, paralysis does not follow the application of dilute solutions there is no reason to assume that motor paralysis never occurs or that when present it is merely a reflex effect.

The cause of the usual circulatory hypotension has been repeatedly sought. Certain experimenters, following an old and discarded theory of traumatic shock, have looked for segregation of blood in the splanchnic veins. Not finding this, the presence of a primary peripheral vasoparesis has been denied. The clear evidence that the peripheral circulation of blood is increased, easily shown by the remarkable rise in the temperature of the extremities under spinal anæsthesia, is overlooked and experiments on dogs paraded to support opinions to the contrary.

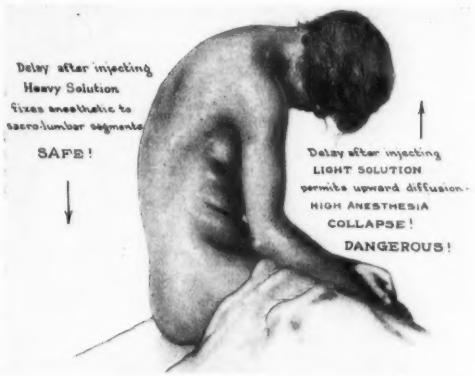


Fig. 1. Illustrating the effect of delay in placing the patient from a sitting to a recumbent position after the injection of spinal anæsthetic solutions lighter than, or heavier than, the cerebrospinal fluid.

Out of much conflicting experimental evidence, an observation of Gray and Parson and supported by experiments of Severs and Waters (loc cit.) is impressive. This is the immediate disappearance of much of the circulatory hypertension when an adequate to and fro type of artificial respiration is established. In other words, circulatory depression is largely the result of paralysis of the muscles of the thoracic cage. The defective inspiratory novements of the chest are attended by a loss of the aspirating effect upon the blood stream. The right heart receives less blood from the venæ cavæ and beats slower and propels less blood. But, you contend, experiments show that the exposed heart of the dog under spinal anæsthesia is primarily dilated and depressed. True, but the experiment was faulty. We know that if the experimenters had not destroyed the respiratory circulatory equilibrium by opening the chest, but had merely studied the dog's heart under the fluoroscope, they would have found the heart contracted rather than dilated under the anæsthetic. Isenberger and Lundy gave a dog 2500 milligrams of procaine (50 per cent solution) by lumbar injection with resultant complete paralysis, yet from adequate inflation and defla-

[1] Researches in Anesthesia & Analgesia, March-April, 1932.

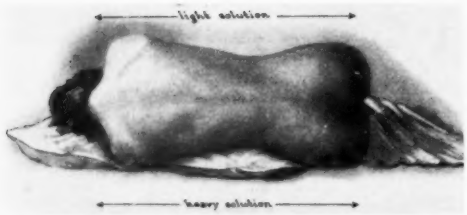


Fig. 2. With the patient remaining upon the side during and after the injection and the spine horizontal, the diffusion of both light and heavy anæsthetic solutions is both cephalad and caudad.

tion of the chest alone the animal was kept alive for 10 hours without change in blood pressure or pulse rate. Unfortunately, we as yet know of no method of maintaining adequate negative pressure in the patient's chest during inspiration while the chest wall is paralyzed by the spinal anæsthetic. As a result, the heart starved of blood beats slower, propels less blood, and the pulse becomes slow and weak. The peripheral vasoparesis is evidently a minor cause of the hypotension.

Demonstrations have been made to show that in the dog harmful peristaltic contractions may occur, so violent as even to tear peritoneal adhesions. Writers have also repeatedly warned against the use of spinal anæsthesia if there is a perforation or rupture of the stomach or intestine. The warning is based on theory not practice. For over 25 years we have operated in nearly every case of a perforated intestinal viscus with spinal anæsthesia and have never observed leakage that coincided with the peristaltic contractions, nor have we seen the contractions tear

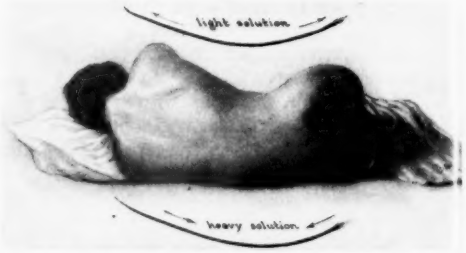


Fig. 3. If the spine is curved toward the operating table a light solution injected in the lumbar region will by gravity diffuse toward the head and sacrum while, other things being equal, a heavy solution will remain in the lumbar curve.

or strain organized adhesions. Indeed, the peristaltic waves under average doses of procaine are mild and often inconspicuous, and we consider the excitement stage of ether as much more potent in causing intraperitoneal leakage or other damage.

But clinical observations and opinion may also be misleading. Modern Galens and Aristotles continue to spin the cobwebs of a fanciful philosophy with spinal anæsthesia as with other debated subjects. Arnaud and Cremieux attribute complications to a meningeal reaction; Leriche to hypotension from leakage of cerebrospinal fluid; Daniel and Valerio to a general sympathetic disequilibrium followed by a colloidoclastic shock. To prevent the supposed humoral crisis Daniel first prepares the patient by an intravenous injection of cerebrospinal fluid. This injection is supposed to desensitize the organism and thus prevent the anaphylactic shock. Measures to render spinal anæsthesia safe have often been based on theory. Jonnesco, in 1908, claimed that strychnine was a perfect antidote for the depression from stovaine. This was not confirmed and 14

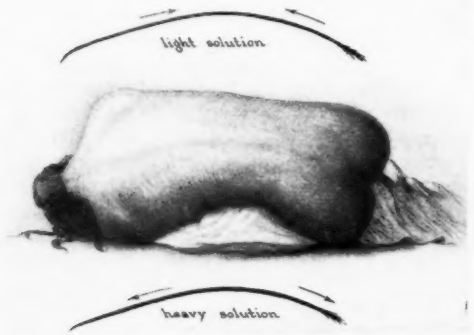


Fig. 4. If the injection is made with the patient upon the side and the spine curved over a pillow, heavy solutions will tend to gravitate toward the head and sacrum. Light solutions remain in the lumbar region with resultant imperfect anæsthesia of the abdomen.

Fig. 5. By turning the patient on the face after the injection of a light solution, a better anæsthesia of the abdomen is thus obtained for the reason that by gravity the solution ascends into the more elevated thoracic curve.

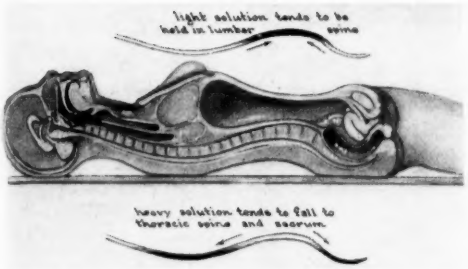


Fig. 6. If, after making the injection with the patient upon the side, the patient is immediately turned upon the back, a light solution by gravity tends to be held in the lumbar spine with lack of anæsthesia in the abdomen. On the contrary, a heavy solution tends to gravitate both into the lower thoracic spine and sacrum and a higher and more complete anæsthesia of the abdomen results.

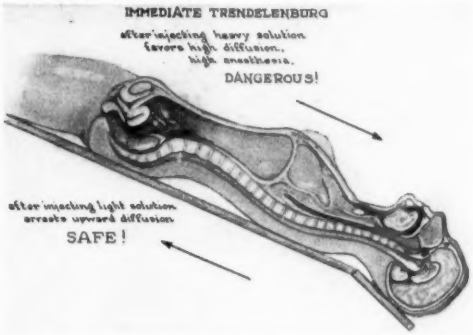
IMMEDIATE TRENDELENBURG
after injecting heavy solution favors high diffusion, high anesthesia.
DANGEROUS!
after injecting light solution arrests upward diffusion
SAFE!

Fig. 7. If, after injecting a heavy solution, such as novocain dissolved in cerebrospinal fluid, the patient is immediately placed in the Trendelenburg position gravitation toward the medulla may produce high and untoward effects. By waiting 10 minutes for the fixation of the anæsthetic to the spinal roots before lowering the upper part of the body, this danger is largely averted. The Trendelenburg position is safe and desirable after the injection of light (alcoholized) anæsthetic solutions.

ears later he extolled caffeine which others had previously used and discarded. Gravity control by the use of heavy solutions advocated by Barker and others has been tried only to be largely abandoned. It has been asserted that the addition of a starch preparation to the solution will prevent diffusion and limit the toxic absorption of novocain, the anæsthetic remaining as a non-diffusible or controllable liquid globule in the dura with resulting efficiency and, from lack of toxic absorption, of great safety. For this fanciful assertion we can find little basis in fact. If you will color with a trace of methylene blue both the spinocaine solution and also a similar solution made without the starch and float the two solutions in tubes containing cerebrospinal fluid, it will be observed that the spinocaine really is the more diffusible. This is probably due to the hygroscopic quality of the starch. In practice a simpler and relatively inexpensive water, alcohol, and novocain mixture shows no loss of efficiency from the lack of gliadin, while the mortality which has attended the use of spinocaine controverts the asserted lack of toxicity. The suggestion that for safety the novice in spinal anæsthesia should spend from 20 to 40 minutes in first dissolving the anæsthetic in blood serum, or that the action should be localized by graded intermittent injections of air and the anæsthetic as advocated by Kirschner, will hardly meet with wide acceptance. A heavy concentrated colloid solution injected without diffusion is much more dangerous from its more intense action on motor roots than a diffused dilute solution which only rarely will produce dangerous motor paralysis.

Most observers also overlook the agitating and diffusing action of the sinuses and veins in the human dura which distend and collapse with each respiratory cycle and of the arterial loops within the arachnoid which oscillate with each heart beat and serve to mix the anæsthetic with the spinal fluid.

In recent years and despite very poor statistical evidence ephedrine has been the talisman of safety for spinal anæsthesia; yet many more deaths have been reported under spinal anæsthesia when ephedrine was given than when it was not given. It is admitted that in part this may be due to the predominant use of the drug. Yet, if there is inadequate oxygenation of the tissues, a condition that so frequently occurs from the circulatory hypotension of spinal anæsthesia, ephedrine not only fails to stimulate, but according to the experiments of Severs and Waters[1] and others, it actually depresses the heart. Indeed, the stimulation produced by ephedrine is lost even when a relatively slight anoxæmia develops. In other words, when most needed this drug not only fails to stimulate but causes circulatory collapse. The electrocardiographic studies of Chen and Meek[2] show the toxic qualities of ephedrine in sufficient dosage, as indicated by progressive paralysis of the conduction bundles and finally, the hopeless condition of ventricular fibrillation. In general practice collapse has been reported in cardiopaths and asthmatics from an idiosyncrasy to ephedrine. With spinal anæsthesia deaths have occurred after the smaller doses of ephedrine as used by Pitkin and the larger doses advocated

[1] Researches in Anesthesia & Analgesia, March-April, 1932.

[2] J. Pharmacol. & Exper. Therapy, 1926, xxvii, 31.

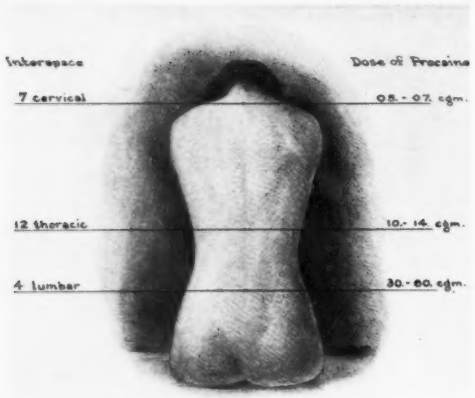


Fig. 8. By diffusion and dilution the efficiency of a spinal anæsthetic is reduced as it travels from the point of injection. Thus 10 centigrams of procaine injected through the twelfth thoracic interspace gives an upper abdominal anæsthesia equal to 30 centigrams injected through the fourth lumbar interspace, while only 5 centigrams injected through the seventh cervical interspace gives an upper thoracic anæsthesia equivalent to 30 centigrams injected through the fourth lumbar interspace.

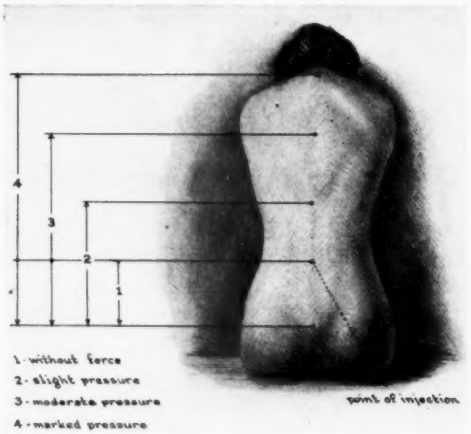


Fig. 9. Illustrating the influence of forcible injection upon the diffusion of spinal anæsthetics. If the injection is introduced without force through the second lumbar interspace a heavy solution falls to the sacrum. By slight pressure, despite a sitting position, the anæsthetic is driven to the lower thoracic spine, while more forcible injections may produce effects upon the thoracic and even cervical nerve roots.

by Stout. After hearing the startling report by Size of 12 deaths in about 200 injections of spinocaine, given in or near Boston, one wonders how the mortality could have been higher had the ephedrine been omitted. No one, as far as I know, has reported as low a mortality from intradural anæsthesia with ephedrine as that we have observed without ephedrine (10,000 injections between deaths). Ephedrine greatly increases the pulse rate and the work of the heart. Because it usually raises the blood pressure and makes the heart beat faster is no proof that it renders the anæsthetic safer. All admit that it is unreliable in the grave emergency. No one contends that it approaches epinephrine as a cardiac stimulant. It is my opinion that such a tricky and potentially dangerous drug should no longer be used routinely. It has been asserted that the action of epinephrine is too transient to be of value in spinal anæsthesia. This, of course, is not true. The period of circulatory stimulation from epinephrine of 15 to 30 minutes is usually longer than the period of intense depression from spinal anæsthesia. By carefully graduated, intermittent, or continuous administration of epinephrine the stimulating effect may be prolonged for hours.

The anæsthetic drug selected has frequently been blamed for the untoward effects of spinal anæsthesia. Cocaine, stovaine, alypin, tropocaine, apothesine, and tutocain have been praised and condemned. Yet cocaine, oldest and most discredited of the intradural anæsthetics continues to be used with much success in the General Hospital of Mexico City. It is also true that the toxic stovaine may be used with a very low mortality. And when all has been said, it is evident that the danger lies more with the user than in the drug, for any of these agents used with skill will give efficient and relatively safe anæsthesia, while the weakest may cause a fatality when used without care. The selection of the patient is especially important. While we admit that procaine from its low general and local protoplasmic toxicity has manifest advantages, we must confess that even cocaine skillfully used may be safer than procaine used carelessly. After a death from spinal anæsthesia the anæsthetist may often properly write his own name in the space on the certificate reserved for "cause of death."

Postanæsthetic headaches have repeatedly been ascribed to the size or shape of the spinal needle used. Large needles and those with acute sharp points are asserted to be responsible for the extradural leakage of cerebrospinal fluid and postanæsthetic headaches. It is claimed that only a very obtuse pointed needle without sharp edges cuts a trap door in the dura which limits leakage and prevents headaches. If one will experiment with a section of dura or similar membrane he will find that the sharp edged, acute point, cuts a better trap door than the relatively dull, obtusely

pointed needle. But while we do not favor a large needle or one with a long point, a well sharpened needle enters the tissue with the least pressure or pain and best conveys to the hand the relative densities of the various tissues traversed. Such a delicate, well sharpened needle inflicts no more pain than the needle so often and so unnecessarily used to anæsthetize the relatively insensitive tissues of the back before the spinal needle is introduced, and is less subject to deviation or harmful or plunging effect on reaching the dura. The needle should be of 20 or 21 B & S gauge. A needle of 22 gauge or finer has too small a lumen, and is too flexible to be properly guided. A needle with an accurately ground slip joint is preferable to a lock joint which requires manipulation that may lead to displacement as the syringe is adjusted.

As for headaches, we have long observed that it is the solution used and not the sharpness or size of the needle that is chiefly responsible. We have largely eliminated postanæsthetic headaches not by changing the needle but by changing the solvent. In the early days, tap water and old distilled water evidently produced meningeal irritation for when without changing the needle fresh triply distilled water was substituted, the heavy incidence of postanæsthetic headaches disappeared. It is quite evident that the needle, and syringe may not be blameless when poorly cleansed, or boiled in tap water, or with other instruments, or in pans with a soluble coating. The intradural reactions resemble, in a measure, those from the intravenous injection of old distilled water or water contaminated by passing through rubber tubing. Unquestionably there is more hysteria than truth in the prevalent notion that leakage is the major cause of headache following intradural anæsthesia.

An old error was the assertion that the spinal anæsthetic, *per se*, causes abducens palsy, with its associated meningism and 6 or 7 day period of incubation. Six of my patients had this startling but fortunately usually temporary affliction after spinal anæsthesia. It is a bacterial effect and in our experience was due to imperfectly sterilized imported solutions. For 20 years, or since we have used aseptic anæsthetic preparations, we have not seen a case.

It has been observed that the zone of anæsthesia is higher and more complete after injecting spinocaine if the patient is turned upon his face for a few moments immediately after the injection. It has been assumed that such a maneuver causes the gravitation of the lighter anæsthetic mixture to the posterior nerve roots. But there

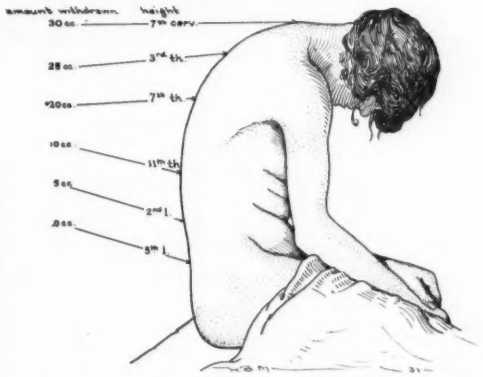


Fig. 10. Even with the patient in a sitting position the upward diffusion and activity of a local anæsthetic injected through a lower lumbar interspace is greatly increased by the previous withdrawal of cerebrospinal fluid. By the withdrawal of 30 cubic centimeters of cerebrospinal fluid, anæsthesia to the neck may be produced.

is really but little anatomical separation of the anterior and posterior roots. The peculiar results obtained are clearly explained by gravity in relation to the spinal curves (Fig. 5). Gravity, volume, and diffusion are three great factors in spinal anæsthesia to be always considered. They cannot be reproduced in the limited intradural space of the dog. But one observer protests that he uses a heavy solution and observes no effect from gravity while another says his technique is the same yet from gravity he has obtained alarming symptoms. Both dissolve novocain in cerebrospinal fluid and reinject it through the same lumbar interspace, but the first man finds he can at once place the patient in the Trendelenburg position while the second has had high and untoward effects from such lowering of the head. Apparently the techniques are the same, but closer study shows important differences. The first dilutes and thoroughly mixes the novocain so that the specific gravity of the injected solution is lowered and the effect on the motor nerves minimal. The second, with the same dose of novocain uses less dilution, so that he really employs a heavier solution that gravitates with greater speed—or it may be that he injects more forcibly and without barbotage and thus aids the movement toward the patient's head of a more concentrated and therefore a more paralysant solution.

I shall not attempt to tell of a better technique for spinal anæsthesia than the one you are using. Most operators are individualists and resent dislodgement from the pet methods that they have

found suited to their personal idiosyncrasies. Nor shall I attempt to impart to you the magical gesture or hocus pocus of safety and efficiency, but if I have impressed you with the thought that fanciful theories may have the support of laboratory and philosophical consideration, that undue credulity does not advance the cause of spinal anæsthesia, and that after all it is wise for each observer to think for himself, the object of this paper will have been accomplished.

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# A SIMPLE METHOD OF PERFORMING EXTERNAL PERINEAL URETHROTOMY

## A Report of Its Value After Fifteen Years

J. DELLINGER BARNEY, M.D., F.A.C.S., Boston

IN the February, 1918, number of Surgery, Gynecology and Obstetrics, I described a method of performing external perineal urethrotomy which so far as I know was original. The operation had at that time been successfully employed by me and by some of my associates in a considerable number of cases, and I felt then that it had stood the test of actual trial. An additional 15 years of experience with it has convinced me that, under appropriate circumstances, it is by far the easiest and most efficient way of establishing perineal drainage.

My original description of the operation may well be repeated for the benefit of those who are unfamiliar with it.

A soft rubber catheter, well lubricated and of suitable size (16 to 18 French scale), is passed through the urethra into the bladder in the usual manner, but it must be inserted until its distal or outer end is almost level, according to circumstances, with the external meatus or with the orifice of the urethra. This end of the catheter is then grasped with a small clamp, preferably with a half-curved shank. The catheter and clamp are then passed on into the urethra until the point of the clamp can be felt pressing against the floor of the bulb. The free portion of the catheter meantime has passed on into the bladder. The point of the clamp is now made to impinge against the perineum, bulging it sharply outward in the median line. An incision from 1 to 2 cubic centimeters in length is now made through the median raphé, the tissues being divided until the point of the clamp, the catheter still in its grasp, is exposed and worked through the incision. The end of the catheter is then firmly held with the fingers or by another clamp, the first clamp being then opened and withdrawn backward from the urethra, thus leaving the catheter emerging from the perineal incision. The catheter is then drawn out until its eye occupies a suitable position within the bladder for uninterrupted drainage. Two transverse sutures are now taken, one above, the other below the catheter, each being tied around it. These sutures should be passed quite deeply so as to include the corpus spongiosum, thus not only controlling whatever bleeding there may be, but also anchoring the catheter firmly in place. Silk sutures are quite satisfactory; those of silkworm gut are better in that if the catheter is not adjusted quite accurately, they can be readily untied and the catheter moved in or out. The urinary stream is now completely and comfortably diverted for as long a time as is necessary.

It was stated in my original communication that this method of perineal urethral drainage was applicable in any operation where diversion of the urinary stream was indicated. These operations include amputation of the penis and plastics for hypospadias and epispadias. In all these operations, the patient is ordinarily placed in the dorsal position. The parts are prepared in the usual manner, this preparation including the skin of the scrotum, the inner aspect of the thighs, and the perineum. The performance of external urethrotomy requires only that the thighs be separated sufficiently to enable the surgeon to expose and incise the midline of the perineum as far posteriorly as possible, but not so far back as to injure the external urethral sphincter or that of the rectum. To do an external urethrotomy by the usual method would involve putting the patient in the lithotomy position, a procedure involving time and disturbance to all concerned.

One word of caution seems advisable. Care must be taken that during the process of passing the clamp through the urethra it is not allowed to open and release the end of the catheter. This

happened once during an operation by one of my assistants with the result that the entire catheter rapidly found its way into the bladder and had to be removed later with a lithotrite.

Experience has taught me that the perineal drainage is best established before the final steps in the primary operation are undertaken. Thus, after an amputation of the penis, the catheter and clamp should be passed before the flaps of mucosa are sutured over the stump; in any of the various plastics the same principle will apply. At times the orifice of the urethra may have to be divided to admit the combined bulk of catheter and end of clamp.

While I have, perhaps unfortunately, kept no data as to the number of cases in which this procedure has been carried out, it is certainly close to one hundred if I include the operations done by my associates. It has been done not only in adults, but in very young boys with hypospadias. Nor have I a record of the number of patients on whom it has been performed more than once. In the case of amputation of the penis, once is enough; where plastic operations have been done for hypospadias a urethrotomy has been performed on each occasion, twice in many, thrice in a somewhat smaller number, and four times in a few. In no instance has there been the least difficulty in doing the urethrotomy, nor has its repeated performance led to the immediate result of delay in closure of the urethral fistula, nor to the remote result of stricture formation, and many of these patients have been seen from time to time over a period of years.

The catheter is attached to a long drainage tube, this being led into a large receptacle. It is kept in place until the sutures of the primary operation have been removed or until the chance of infecting the wound was remote.

After the catheter is removed, it has been found that the perineal sinus will close spontaneously in from 1 to 4 or 5 days, after which time micturition becomes entirely normal and comfortable. In conclusion it seems important to state that hæmorrhage from the bulb has never been in the least troublesome, nor, so far as I can recall, has it failed to be controlled by the two transverse sutures which I have described.

# THE NARROW BISPINOUS DIAMETER AND THE PERSISTENT OCCIPITOPOSTERIOR POSITION

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THE funnel pelvis, and particularly the ischial spines, have long been suspected as possible factors in the etiology of the persistent occipitoposterior position. As early as 1855 Sir James Y. Simpson stated that the spines of the ischia contribute far less (to rotation) than is generally believed. In 1896 Klien called attention to the frequent occurrence of the posterior position in funnel pelves.

In the recent literature only an occasional reference to the subject is to be found. In 1916, Cragin stated: "In the occipitoposterior position there is poor flexion, the occiput and sinciput reaching the pelvic floor at the same time, and rotation is prevented by the spines of the ischia."

Harper more recently presented a similar opinion.

The views expressed in the literature, although covering a period of many decades, are vague and conflicting, and are based on personal impressions and not on statistical data. Careful consideration, however, shows that the subject deserves more than the cursory attention that it has received. The practical importance of the problem becomes apparent when it is recalled that the course of labor is most eventful at the level of the ischial spines, particularly in occipitoposterior positions. It is here that the cardinal movements of internal rotation and descent must occur simultaneously, while flexion must be maintained or re-established. These important events have never been investigated with reference to the narrow bispinous diameter. The object of the present study is, therefore, to determine what influence, if any, the narrow bispinous diameter may exert on the mechanism of labor; particularly in so far as the incidence of the persistent posterior position is concerned.

The work was undertaken in 1929, when a special pelvimeter for the measurement of the bispinous diameter became available (6). A preliminary report on the results obtained was presented in 1931 (7) before the Section on Obstetrics and Gynecology of the California Medical Association.

## CLINICAL DATA

Observations were made on a series of 2,254 consecutive cases; 811 of these were primiparæ. The bispinous diameter was measured in all of these cases by the writer personally and all the operative deliveries were performed by him. The average measurement was found to be 10.51 centimeters. Pelves with a bispinous diameter of 9.5 centimeters or less were rather arbitrarily classed as narrow, and those measuring over 9.5 centimeters as normal or large. According to this classification there were 143 pelves with a narrow bispinous diameter among the primiparæ.

Positions were regarded as posterior when the occiput was found behind the transverse diameter of the pelvis at the time of delivery. However, cases in which partial rotation had occurred to occiput right or left transverse were also counted as posterior positions. The occiput posterior was considered as persistent when there was no progress in rotation or descent after efficient second stage pains continuing for a period of at least 2 hours in primiparæ, or 1 hour in multiparæ, after rupture of the membranes. Only cases in which the head was well engaged were included in the series, since the influence of the ischial spines cannot come into play unless the head descends down to the level of the narrow pelvic plane. Cases of persistent posterior position occurring in premature deliveries were excluded for obvious reasons. The commonly accepted standard, a birth weight of 2,500 grams or less, was considered as evidence of prematurity.

In attempting to classify the data obtained, it became apparent that, in the interpretation of statistics bearing on the etiology of the persistent posterior position, parity must be given first consideration. Confusion is unavoidable unless a clear distinction is drawn between primiparæ and multiparæ in all such discussions, and yet the subject has seldom been approached from this aspect even in the more elaborate statistical reports. Progress has undoubtedly been greatly retarded through this oversight.

In the present study attention will be focused on the occipitoposterior position in primiparæ, since in multiparæ the relaxed perineum is a complicating factor, predisposing to the persistence of the posterior position.

*Incidence in primiparæ.* A perusal of Table 1 shows that the bispinous diameter is narrow in 27 of 38 (71.0 per cent) of the cases of persistent

occipitoposterior position. The measurement exceeds 10.5 centimeters in only 1 of the 38 cases. These findings are even more striking when it is recalled that the narrow bispinous diameter occurs in only 17.67 per cent of the cases. The average measurement for the group is only 9.46 centimeters as compared with the normal of 10.51 centimeters.

Conversely, there is an exceedingly high incidence of the persistent posterior position among this group of pelves—27 among 143 cases (18.9 per cent). This is an incidence almost as high as that given in the recent literature (2, 5, 7, 10, 13) for unselected cases of the occipitoposterior position early in the first stage of labor, and is approximately thirteen times greater than the incidence of the persistent posterior in the group of 668 primiparæ with normal bispinous diameters.

*Other pelvic measurements in primiparæ.* The sacropubic or anteroposterior diameter of the narrow pelvic plane was measured in 24 unselected cases of persistent occipitoposterior position. The average measurement was approximately normal in this series, although the bispinous diameter showed the usual degree of contraction.

The biischial diameter was found to be moderately narrow, the average measurement being 9.90 centimeters (the average for the entire series was 10.79 centimeters). In 7 of the 27 cases, however, in which the bispinous diameter was narrow, the biischial was normal or large. The biischial diameter is thus less frequently associated with the persistent posterior position than is the bispinous diameter.

The biischial diameter was sufficiently narrow in only 2 cases to form a probable obstacle to descent (Cases 22 and 26).

The other pelvic measurements were essentially negative with the exception of a moderate degree of general contraction in Cases 3, 7, 20, 26, and 30, and an oblique contraction (tuberculosis of hip) in Case 36.

*Incidence in multiparæ.* Among 52 cases of persistent occipitoposterior position in multiparæ in this series there were 18 cases with a narrow bispinous diameter, an incidence of only 34.6 per cent.

### INFLUENCE OF NARROW BISPINOUS DIAMETER ON OCCIPITOPOSTERIOR POSITION IN PRIMIPARÆ

The data presented show that in this group there is a very frequent association between the persistent occipitoposterior position and the narrow bispinous diameter. This observation can be readily explained by a consideration of the mechanism of labor.

TABLE I.—PERSISTENT OCCIPITOPOSTERIOR POSITION IN PRIMIPARÆ

| Case | Biischial diameter | Bispinous diameter | Weight in gms. | Type of delivery |
|---|---|---|---|---|
| 1 | 11.5 | 9.2 | 3577 | Manual rotation and midforceps |
| 2 | 11.5 | 9.5 | 3163 | Manual rotation and midforceps |
| 3 | 10.0 | 9.4 | 4145 | Version |
| 4 | 9.5 | 9.0 | 4040 | Manual rotation and midforceps |
| 5 | 9.0 | 8.8 | 3090 | Manual rotation and midforceps |
| 6 | 9.5 | 9.3 | 3520 | Manual rotation and midforceps |
| 7 | 9.0 | 8.8 | 3577 | Cæsarean (occiput right transverse) |
| 8 | 10.5 | 9.0 | 3945 | Kielland midforceps |
| 9 | 10.0 | 9.5 | 3068 | Manual rotation and midforceps |
| 10 | 11.5 | 9.5 | 3831 | Manual rotation and midforceps |
| 11 | 9.5 | 9.2 | 4659 | Manual rotation and midforceps |
| 12 | 10.0 | 10.0 | 2547 | Spontaneous (occipitosacral) |
| 13 | 10.0 | 8.8 | 3068 | Manual rotation and midforceps |
| 14 | 10.5 | 11.0 | 3236 | Spontaneous (occipitosacral) |
| 15 | 10.5 | 9.2 | 3236 | Spontaneous (occipitosacral) |
| 16 | 10.5 | 9.0 | 4004 | Manual rotation and midforceps |
| 17 | 10.0 | 9.5 | 3804 | Manual rotation and midforceps |
| 18 | 10.0 | 10.0 | 3068 | Kielland low forceps |
| 19 | 10.5 | 10.2 | 3295 | Kielland low forceps |
| 20 | 10.0 | 8.8 | 3804 | Manual rotation and midforceps (occiput right transverse) |
| 21 | 8.5 | 8.5 | 2527 | Manual rotation and midforceps (1st of twins) |
| 22 | 8.5 | 9.1 | 3718 | Kielland low forceps |
| 23 | 10.0 | 10.2 | 3363 | Spontaneous (occipitosacral) |
| 24 | 10.5 | 10.2 | 4005 | Spontaneous (occipitosacral) |
| 25 | 10.0 | 10.3 | 3780 | Manual rotation and midforceps (occiput right transverse) |
| 26 | 8.5 | 8.5 | 3360 | Caesarean (occiput left transverse) |
| 27 | 9.5 | 9.3 | 4020 | Manual rotation and midforceps |
| 28 | 10.3 | 10.3 | 3720 | Spontaneous (occipitosacral) |
| 29 | 8.6 | 8.6 | 3330 | Spontaneous (occipitosacral) |
| 30 | 8.6 | 8.6 | 3180 | Kielland midforceps |
| 31 | 10.5 | 10.5 | 3300 | Manual rotation and midforceps |
| 32 | 9.5 | 9.0 | 3540 | Manual rotation and midforceps |
| 33 | 9.5 | 9.9 | 3990 | Spontaneous (occipitosacral) |
| 34 | 9.5 | 8.8 | 3405 | Spontaneous (occipitosacral) |
| 35 | 10.0 | 10.2 | 5100 | Low forceps (occipitosacral) |
| 36 | 11.5 | 9.4 | 3870 | Low forceps (occipitosacral) |
| 37 | 9.5 | 9.0 | 4110 | Low forceps (occipitosacral) |
| 38 | 9.5 | 9.2 | 3120 | Spontaneous (occipitosacral) |
| Average | 9.90 | 9.46 | 3580 | |

Deflexion is generally considered one of the most important factors in the etiology of the persistent posterior position. The maintenance of flexion, of course, depends on the circumstance that the forces acting against the sinciput must overbalance those exerted against the occiput. Accordingly, any factor that increases the resistance which the occiput encounters, tends to favor deflexion. It seems that a narrowing of the bispinous diameter would have just this effect of causing obstruction to the advance of the occiput, with deflexion as an inevitable consequence. Aside from this effect on flexion the narrow bispinous diameter would tend to hinder rotation directly by offering increased resistance to the presenting part which, as a result of the deflexion, is considerably larger, and ovoid rather than spherical, approaching the suboccipitofrontal plane in both size and contour. Descent would likewise be obstructed due to the contraction of the bispinous diameter, and the general increase in the plane of the presenting part. Furthermore, due to the insufficiency in descent, the presenting part may not come into intimate contact with the pelvic floor. The favorable influence of the levator ani muscles on rotation would, therefore, remain in abeyance, and the sole advantage of primiparity would thus be lost. These complications would be apt particularly to develop under the circumstances of weak pains and great soft tissue rigidity, as in elderly primiparæ. A deadlock thus results—descent is obstructed because of the persistence of the posterior position coupled with the deflexion attitude, while rotation comes to a standstill due to the arrest in descent. In other words, a vicious cycle is established; there is no rotation without descent, and no descent without rotation or flexion. An escape from this vicious cycle is unlikely in primiparæ, since the powers are seldom equal to the task of overcoming the soft tissue rigidity plus the bony resistance offered by a narrow bispinous diameter. All progress therefore ceases, with the head in a deep posterior or "transverse arrest." From the foregoing discussion it is apparent that, in occipitoposterior positions, the narrow bispinous diameter may exert a serious disturbing influence on the mechanism of labor, directly obstructing all three of the movements occurring in the lower midpelvis, namely, flexion, rotation, and descent. In view of these considerations the persistence of the posterior position in pelves with a narrow bispinous diameter is readily accountable.

The high incidence of the narrow biischial diameter in cases of persistent occipitoposterior position is a complicating factor that must be taken into account. The common association of the narrow biischial diameter with these cases is to be expected, since there is a certain parallelism between the width of the biischial and bispinous diameters. It seems that the narrow biischial diameter cannot interfere with rotation when the largest plane of the presenting part is at the level of the spines or higher. Furthermore, the ischial tuberosities are situated too far anteriorly, and at too low a level to cause deflexion, or directly to oppose rotation, even when the head is at the outlet. However, when the station of the head is low, an associated narrow biischial diameter may well be more than a mere coincidence, since under these circumstances it may indirectly form an obstacle to rotation by causing obstruction to descent. It seems, therefore, that any inhibiting effect which the narrow biischial diameter may exert on rotation would largely be only secondary, or accessory to the influence of the factors responsible for the persistence of the posterior position at the level of the spines.

Recently, Thoms made the observation that in pelves with transverse contractions of the inlet, engagement occurs almost invariably in the occipitoposterior position. This finding is important, but it has little direct bearing on the present study, since it does not explain the persistence of the posterior position at lower levels of the pelvis, a subject with which the present work is particularly concerned.

### INFLUENCE OF NARROW BISPINOUS DIAMETER ON OCCIPITOPOSTERIOR POSITION IN MULTIPARÆ

The lower incidence of the narrow bispinous diameter among cases of persistent posterior position in multiparæ is probably due to the relaxed perineum. This is a complicating factor which, of course, predisposes to the persistence of the posterior position regardless of the width of the bispinous diameter, and thus causes a relative decrease in the incidence of the narrow bispinous diameter among this group of cases.

### PRACTICAL BEARING ON TREATMENT

In view of the fact that spontaneous anterior rotation occurs in the majority of cases, the conventional attitude toward the occipitoposterior position is one of "watchful expectancy." A policy of non-interference is generally recommended until operative intervention becomes urgent for the relief of "maternal exhaustion" or "fetal distress." The reward for such conservatism is spontaneous anterior rotation in more than 80 per cent of the cases. Unfortunately, however, the patients in the remaining smaller group, n

whom the occiput fails to rotate, are little benefited by the delay thus occasioned. In fact, positive harm comes in these cases of persistent posterior position through an undue prolongation of the second stage, since the malposition becomes less amenable to correction due to caput formation, excessive moulding, and increased deflexion, as well as uterine spasticity and the tendency to the formation of a contraction ring. Version also becomes very hazardous or altogether impossible. These difficulties and dangers are multiplied by other well known ill effects of an unduly protracted second stage; viz., added suffering, exhaustion, tendency to postpartum hæmorrhage, and possible intracranial injury to the fetus.

Certain writers, particularly Bill and his followers, have been so impressed with the frequency and seriousness of the complications named as to advocate active treatment early in the second stage in practically all cases of the occipitoposterior position. Such a course of management would, however, entail an unjustifiably high incidence of operative interference with its attendant increase in morbidity and mortality. On the other hand, the purely expectant treatment would best serve only the interests of the group of cases in which spontaneous rotation ultimately occurs, but would be decidedly detrimental to the cases of persistent posterior position.

In occipitoposterior positions complicating labor in elderly primiparæ, or in borderline cases of disproportion, cæsarean section may come up for consideration. In such cases the posterior position, if persistent, may well be a factor of decisive importance in favor of section. It is therefore imperative that the persistence of the malposition be anticipated early in labor—before abdominal delivery becomes contra-indicated.

In view of these considerations it becomes highly desirable for purposes of rational treatment to find means of differentiating early in labor the cases which are most likely to remain in the posterior position from those in which the outlook is good for spontaneous anterior rotation. This differentiation is now greatly facilitated with the ready means available for the measurement of the bispinous diameter, and with the knowledge that anterior rotation takes place relatively infrequently in pelves with a narrow bispinous diameter, but does occur as a rule in pelves with a normal or large measurement. This, as already intimated, applies chiefly to primiparæ. In multiparæ the width of the bispinous diameter does not bear a sufficiently constant relationship to the posterior position to be of much value as a guide in treatment.

From the evidence presented it follows that in primiparæ in whom the bispinous diameter is narrow it may be permissible for practical purposes, to consider cases of posterior position as persistent, if rotation fails to occur after a brief test of the second stage. Early intervention, under such circumstances, will eliminate what would otherwise be in most of these cases, a long and futile second stage, with its attendant difficulties and disastrous complications. Whereas, in the group of primiparæ in whom the bispinous diameter is normal or large, an ultraconservative course may be followed with full confidence that anterior rotation will occur spontaneously in the great majority of the cases unless there is either uterine inertia or marked disproportion.

It seems that the above basis for selective treatment should give better results than a rather arbitrary policy of purely expectant or very radical management. However, a final appraisal of the merits of the plan proposed must come from a comparative analysis of the incidence of the morbidity and mortality in large series of cases treated by the methods under consideration.

SUMMARY

In a series of 143 primiparæ in whom the bispinous diameter was found to be narrow, there were 27 cases (18.9 per cent) of persistent occipitoposterior position. This incidence is approximately thirteen times greater than the incidence of the persistent posterior position in pelves with a normal bispinous diameter. The persistence of a posterior position may therefore be anticipated early in labor if the bispinous diameter is narrow; and operative intervention may be instituted under the most favorable circumstances.

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# PLACENTA PRÆVIA

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THE avoidable maternal mortality from placenta prævia throughout the civilized world, as shown by recent surveys, emphasizes again the grave lack of knowledge of the fundamentals in the care and treatment of this condition by those attending the pregnant woman.

Quoting from "Maternal Mortality in New York City," in which a group of physicians have carefully outlined the factors involved, we find these conclusions: "It is evident that the prenatal course of these women was improperly supervised, either through their own ignorance in disregarding what seemed to be trivial bleeding, or through the failure of the attendant to evaluate the symptoms and institute proper treatment. The frequency with which the patient was neglected even after a really significant hæmorrhage which pointed most emphatically to the existence of placenta prævia, is an indication that the gravity of the situation was only poorly grasped by the attendants. It is vital that the attendant inform the patient categorically that bleeding during pregnancy is never trivial and may be and often is the warning of disaster. Furthermore, the treatment in these cases was frequently improper. The choice of operation as well as the time of its performance must be judicious. Rapid traumatizing delivery by the birth canal must be avoided as it increases the hazard to the mother."

Of 7,537 obstetrical deaths in 15 states during the years 1927 and 1928 studied by the Children's Bureau of the Department of Labor, there were 408 who had placenta prævia. Of these 408 cases 347 deaths were directly due to placenta prævia while 61 were also complicated by sepsis; 239 women were reported to have had delayed treatment, the delay being due to the doctor in 129 cases and due to the patient, family, or circumstances in 110 cases.

Fifty-two per cent of those 408 cases were delivered by podalic version and extraction, 10 per cent by cæsarean section, 8 per cent by forceps, 4 per cent by manual dilatation of the cervix, and 7 per cent by other operative means. There seemed to be considerable misunderstanding on the part of the doctors regarding the dangers of version and extraction with immediate delivery and the Braxton Hicks maneuver with delayed extraction. As a matter of fact, the latter was rarely done. Rupture of the uterus, tears, hæmorrhage, and shock were frequent. So large a number died immediately after delivery that relatively few lived long enough to die of sepsis. The treatment of shock and hæmorrhage was conspicuous by its almost entire absence. Fluids of any sort were rarely used. That the buttocks of the child could be used to control hæmorrhage and that shock could be treated at this time was practically never considered. Cæsarean sections were often done without any effort being made to combat the patient's shock.

Such a report emphasizes the grave lack of knowledge of cardinal obstetrical principles by a large number of doctors attending the parturient woman.

The statistics reported in this paper are primarily from the Chicago Lying-in Hospital since its affiliation with the Department of Obstetrics and Gynecology of the University of Chicago 2½ years ago. Included are also the statistics from such cases in the 4 years previous at the old Chicago Lying-in Hospital.

The incidence of this pathological condition has been 1 in 115 cases delivered in the hospital. Only cases in which the placenta was palpated or seen covering, partially covering, or bordering on the internal os are included. No cases of low implantation have been included. Placenta prævia totalis is the terminology used for any case in which the internal os is completely covered with placental tissue when the patient is examined. Partialis and marginata describe those cases in which the internal os is partially covered or bordered by the placenta.

Patients who are bleeding or have a history of bleeding, who are seen in their homes by the internes of the home service department, are transferred to the hospital immediately without rectal or vaginal examination being made. Prospective donors among the family and friends accompany her.

Any patient 20 weeks or more pregnant admitted bleeding vaginally or with a history of vaginal bleeding is immediately prepared for sterile vaginal examination. Typing of the patient's blood and cross matching with available donors is done while the operating room staff sterilizes bags for intra-uterine insertion should they be needed. Instruments for cæsarean section

are always in readiness. If the patient is in shock, appropriate medication, heat and subcutaneous or intravenous fluids, are immediately given. Although only 10 to 20 per cent of the cases so examined prove to have placenta prævia or abruptio placenta, nevertheless the same rigid routine is followed for each case. The patient primarily presenting the least symptoms may prove to be the most serious emergency when examined.

Combating shock and hæmorrhage by means of blood transfusion and the administration of fluids, before or during delivery, in the patients who have had any blood loss is as important as the method of delivery chosen. In emergency cases a well trained operating and transfusion team have to function almost simultaneously.

Dieckmann has used 30 cubic centimeters of a 30 per cent solution of sodium citrate administered intramuscularly or 15 cubic centimeters intravenously as had been found by Neuhof and Hirshfeld to shorten the coagulation time and thus prevent blood loss.

Before the methods of delivery are discussed it should be recalled that there is no standard form of treatment for all cases. In a patient with a living viable fetus, if the vaginal examination reveals the cervix partially dilated with effacement and the placenta marginally situated, rupture of the membranes allowing the head to come down acting as a compressor may be sufficient treatment. Otherwise the insertion of a bag will control the bleeding or the fetal scalp may be grasped with the Willett forceps and traction applied.

There are a few cases with previable or already dead infants where the cervix is only slightly dilated that the intraovular introduction of a bag or a Braxton Hicks version with delayed extraction may be done. Kerr found that the bag had a very limited usefulness in the treatment of placenta prævia. Occasionally a patient's cervix will be completely dilated or dilatable when first examined, allowing a version and extraction or forceps delivery if spontaneous delivery is not imminent. If a Braxton Hicks maneuver has been decided upon, one may attempt, first, an external version bringing a foot over the cervix thus preventing the dangers of an intra-uterine insertion of the hand causing separation of the placenta.

McPherson advocates tamponading the cervix with iodoform gauze strips where the child is dead or non-viable; when the cervix becomes sufficiently dilated the child is extracted in the manner chosen by the operator. It should be remembered that, as Kerr states, "all statistics go to prove that packing of the cervix in placenta prævia adds materially to the mortality and morbidity rates unless it is carried out under the strictest antiseptic precautions."

TABLE I.—TREATMENT AND RESULTS

| | Cases |
|---|---|
| **January, 1927 to May, 1931 — Seventy-six cases** | |
| Type of placenta prævia. | |
| Marginalis | 50 |
| Partialis | 9 |
| Totalis | 17 |
| Methods of treatment | |
| Low cervical cæsarean section | 28 |
| Porro cæsarean section | 2 |
| Vaginal cæsarean section | 1 |
| Braxton Hicks | 10 |
| Breech extractions | 8 |
| Forceps | 11 |
| Spontaneous | 16 |
| Results | |
| Maternal mortality | None |
| Fetuses lost | 31 |
| Non-viable dead on admission or monsters (below 1500 grams) | 22 |
| Viable and living on admission | 9 |
| Total fetal mortality, per cent | 41 |
| Corrected fetal mortality, per cent | 10.7 |
| **May, 1931 to January, 1934 — Sixty-three cases** | |
| Type of placenta prævia | |
| Marginalis | 21 |
| Partialis | 10 |
| Totalis | 32 |
| Methods of treatment | |
| Marginalis— | |
| Spontaneous rupture of membranes | 9 |
| Insertion of bag | 4 |
| Braxton Hicks | 1 |
| Low cervical cæsarean section | 7 |
| Partialis— | |
| Spontaneous rupture of membranes | 0 |
| Insertion of bag | 5 |
| Braxton Hicks | 2 |
| Low cervical cæsarean section | 2 |
| Porro cæsarean section | 1 |
| Totalis— | |
| Spontaneous rupture of membranes | 0 |
| Insertion of bag | 3 |
| Braxton Hicks | 5 |
| Low cervical cæsarean section | 21 |
| Porro cæsarean section | 3 |
| Results | |
| Maternal mortality | none |
| Fetuses lost | 14 |
| Dead on admission (above 2500 grams) | 3 |
| Died within 24 hours of delivery (1500 to 2500 grams) | 4 |
| Died (below 1500 grams) | 7 |
| Total fetal mortality, per cent | 22.2 |
| Corrected for those dead on admission and those weighing 1500 grams, per cent | 6.3 |
| Average age of patients, years | 29.7 |
| Primiparæ, cases | 18 |
| Multiparæ, cases | 45 |
| Average antepartum blood loss, c.cm | 360 |
| Average intrapartum blood loss, c.cm | 500 |
| Total blood loss | 860 |
| Number of patients having blood transfusions | 15 |
| Percentage | 23.8 |
| Weeks pregnant | |
| 20 to 30 weeks | 8 |
| 30 to 35 weeks | 7 |
| 35 to 40 weeks | 31 |
| 40 or more weeks | 17 |

Ligation of the uterine arteries through the vagina as described by Miller in 1907 and Kerwin in 1926 might well be a life saving procedure in an emergency when facilities for an immediate operation are not available. Henkel's clamps for the broad ligaments may also be used.

Any patient diagnosed as having a placenta prævia with an uneffaced rigid cervix and practi-

TABLE II

| Author | No. of cases | Year of report | Predominating method of treatment | Maternal mortality | Fetal mortality, gross | Fetal mortality corrected |
|---|---|---|---|---|---|---|
| Essen-Möller Lund | 132 | 1921 | 55 spontaneous or rupture of membranes<br>51 Braxton Hicks<br>16 Cæsarean—vaginal<br>7 Cæsarean—abdominal | 3.7 | 45.6 | |
| Moskowitz Jewish Maternity New York | 158 | 1909–1930 | Bag and Braxton Hicks mostly | 7.5 | 41.7 | 31.6 |
| Siegel University of Maryland | 115 | 1920–1929 | Cæsarean section and Braxton Hicks | 6.08 | 44.86 | 31.6 |
| Kellogg Boston Lying-in Hosp. | 151 | 1915–1925 | Bag and Braxton Hicks | 8.6 | 54. | |
| Kellogg Boston Lying-in Hosp. | 26 | 1927–1930 | Cæsarean section | 3.86 | 22.7 | |
| Irving Personal Cases | 57 | | Bag and Braxton Hicks | 3.5 | 57.9 | 45. |
| Brodhead and Langrock Harlem Hosp. New York | 165 | | Mostly Braxton Hicks | 10.9 | 66.6 | |
| Peckham Johns Hopkins Hospital | 146 | 1896–1930 | Mostly bag | 10.96<br>8.64 for past 10 yrs. | 67.81 | 38.71 |
| Rotunda Hospital | 102 | 1927–1931 | Mostly Braxton Hicks | 1.9 | 52 | |
| Group of Five Large British Hospitals | 1083 | 1926–1930 | | 8.4 | | |
| Bill Cleveland | 104 | 1922–1930 | 78 per cent by cæsarean section | 1.92 | 30.76 | |
| Chicago Lying-in Hospital | 76 | 1927–1931 | 39.4 per cent by cæsarean section | 0 | 41. | 10.7 |
| Dept. Obst. & Gynec. Univ. of Chicago | 63 | 1931–1934 | 54 per cent by cæsarean section | 0 | 22.2 | 6.3 |
| | 139 | | | | | |

cally all cases of placenta prævia totalis, if in a hospital in competent hands should be delivered abdominally as the danger of hæmorrhage intrapartum and postpartum is much greater than the mortality from cæsarean section. The advent of cæsarean section in the treatment of placenta prævia has not only materially lowered the maternal mortality but has almost eliminated deaths of viable babies that were living when the patient was examined. Whereas the gross fetal mortality was formerly 60 to 80 per cent, it is now as low as 22 per cent.

In this clinic the low cervical cæsarean section with routine packing of the uterine cavity is used and has proved most satisfactory.

In Table I are shown the various methods of treatment employed for each type of placenta prævia. The results in this clinic, 139 consecutive cases over a period of 7 years, without maternal mortality emphasize the necessity of individualizing each case and of such extreme caution in the preliminary examinations and pre-operative care. *There have been no corrections in the maternal mortality.* The gross fetal mortality includes all fetal deaths no matter what the weight or whether they were monsters or stillborn. The corrected fetal mortality eliminates fetuses under 1,500 grams in weight, those stillborn on admission, and monsters (Table I).

The results obtained from a few comparable series of cases of placenta prævia have been abstracted from a large amount of material on this subject and are presented here for comparison. The best results have come from hospitals where cæsarean section is the predominating method of treatment or the cases were handled by a single skilled individual, with the notable exception of the Rotunda in Dublin where the Braxton Hicks maneuver is the preferred treatment in most cases (Table II).

## CONCLUSIONS

1. The maternal mortality from placenta prævia in a well equipped maternity hospital should approach very closely to zero.

2. The corrected fetal and neonatal mortality from placenta prævia can be materially reduced under ideal conditions and is now approximating the fetal and neonatal death rate from other causes.

3. The high maternal mortality from placenta prævia over the country as a whole is largely due

to carelessness or ignorance of the patient's physician or to inadequate facilities for proper maternal care.

Since this paper was written there have been 16 additional cases treated in this clinic without maternal mortality.

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# CORRESPONDENCE

## EARLY AMERICAN HOSPITALS—"OLD BLOCKLEY"

THE following are excerpts from a letter which we have received from John N. Hatfield, superintendent Pennsylvania Hospital, in reference to the article by Dr. Temple Fay on "Old Blockley," published in the April, 1934, issue of SURGERY, GYNECOLOGY AND OBSTETRICS, pp. 797-804.

*To the Editor:* Our attention has been called to the article regarding Old Blockley by Dr. Fay, and we are constrained, in the interests of accuracy, to call attention to certain source material which establishes the priority of the Pennsylvania Hospital in the hospital field.

Dr. Fay makes the statement, p. 797, that "Blockley" is "the first organized unit for the care of the sick and needy to be founded on the American continent" and offers many interesting dates, references, specific and general statements in support. Let me say here that the Pennsylvania Hospital claims to be the oldest hospital founded as such in the British Colonies in North America. This claim is based on authentic, historical source material now in our archives.

I will take up several of the references and statements in the order in which they occur in Dr. Fay's interesting article.

1. p. 797—reference to the Friends Almshouse, 1712 and the legislative loan for an Almshouse or Hospice in 1729. The Friends Almshouse was established by the Society of Friends and was in no sense a city institution—see any standard work on early Philadelphia History.

2. p. 798—statement, Pennsylvania Hospital was founded in 1753. Application for a charter for the Pennsylvania Hospital was read before the Provincial Assembly on January 23, 1751. This application while first mentioning the insane also enumerates other diseases to be treated, thus clearly establishing the intention to open a general hospital. This paper is in our archives today. Organization was completed May 1, 1751, and applications for admission of patients first received February 10, 1752, at which time the Overseers of the Poor asked admission for their inmates (1st minute book, p. 22).

3. p. 798—general statement to show early clinical instruction at "Blockley."

4. p. 800—the first ward instruction. "Clinical" teaching and "ward" instruction are so interwoven that I comment on these two references as one. Teaching by members of the staff and on the wards of the Pennsylvania Hospital as early as 1762 is shown by the managers' minute books from which I excerpt the following:

p. 327—2nd minute book—9th 11th mo. 1762:

Adjourned meeting of the Board to open 3 cases of anatomical paintings and casts sent by Dr. Fothergill for Dr. Shippen's use in instructing students—"And if any professor of anatomy is desirous to exhibit Lectures he is to apply to them (the Managers) for Liberty. All such Pupils as attend the said Lectures intended to be exhibited by Dr. Shippen or any other Person should pay a Pistole each."

p. 372—2nd minute book—10th 5 mo. 1763:

And it being remarked that a number of students in Physic do frequently attend the wards at the time of the Physicians visiting the Patients with a view to improve themselves in experience, it is the unanimous opinion of the board that such of them at least

who are not apprentices to the Physicians of the House—should pay a proper Gratuity for the Benefit of the Hospital for their privilege, the consideration of Stipulating the sum is referred to the next board for consulting w^th^ ye Physicians.

p. 373—2nd minute book—The Board met with Dr. Wm. Shippen, Jr., 17th 5th mo. 1763 and agreed that he should use the paintings for a lecture to any interested persons once a fortnight during that summer.

p. 278—3rd minute book—A special meeting of the board and the physicians was held at the home of Dr. Thomas Bond who

Read in our presence an Essay on the Utility of Clinical Lectures, and a plan for executing the same for the benefit of Students in Physic, and promoting the purposes of this Institution . . . . as follows . . . .

The minutes note the lecture was given in the hospital December 3, 1766.

5. p. 798—statement to show probable origin in "Blockley" in 1774 of gratuitous professional service to the public confined to charitable institutions.

p. 14—1st minute book—23rd 10th mo. 1751.

The Board were acquainted that Dr. Lloyd Zachary, Drs. Thomas and Phineas Bond were willing to give their Attendance gratis in taking care of the Sick as Physicians and Surgeons for the first three years; the President is desired to give them the Thanks of the Board for this generous offer; and to request Drs. Graeme, Cadwalader, Moore, and Redman to assist in Consultation on extraordinary Cases.

This arrangement continues today.

p. 84—1st minute book—The summary of the first year's work shows 54 admissions to the hospital between February 11, 1752, and February 10, 1753, and of these 18 paid sums ranging from 15 shillings for a stay of 10 days to £12.18.4 for a stay of 7 mo. 22 days, the remaining 36 paid nothing at all.

6. p. 800—statement of establishment of "outdoor" medical relief.

p. 26—1st minute book. Board meeting of 2nd of 4th month, 1752.

A dropsical Person apply'd as a Patient but having the Itch was admitted as an Out-Patient at the Expense of the hospital for two Weeks.

p. 67—1st minute book. Board meeting of 4th of the 1 mo. 1753.

John Small was admitted on the 13th (of December, 1752) to be treated as an out-patient, his Case a periodical Madness . . . . and the Medicines of the Hospital were allowed to be administered to Mary Barton an out Patient.

Bear in mind that all of these patients were sick, either mentally or physically, when admitted and were admitted for the express purpose of having a cure effected—in no case was the admission based on poverty or dependency.

7. p. 800—establishment of residentship in 1788.

"Residents" at the Pennsylvania were appointed in the early days as shown by the following:

p. 66—1st minute book—12th of 12 mo. 1752.

Agreed that an Apothecary be employ'd to prepare & compound the Medicines and Administer them Agreeable to the Prescriptions of the Physicians & Surgeons and that he shall give Bond with Sureties to the Managers for the faithful performance of hi Duty.

p. 254—4th minute book—shows the appointment of the first medical apprentice (interne)—Board meeting of the 26th 7 mo. 1773:

Jacob Ehrenzeller Jun'rs Indenture to serve 5 years and 3 months being executed on the 1st of last month in the presence of his Father and Samuel Coates, was now produced and read, and deposited with other papers by the Clerk, the Terms agreed on with his Father, besides what is generally expressed in the Indenture as follows, viz.: That he shall have leave at his own or his Father's Expence to attend the Lectures of the Medical Professors out of the Hospital during the two last years of his apprenticeship, to attend the Surgical operations and lectures in the Hospital free of any Expence; and that the Apothecary for the time being shall duly instruct him in Physic and Surgery.

8. p. 801—statement by the Poor Board in 1805 that Pennsylvania Hospital charged "more than an equivalent for board and lodging."

9. p. 801—statement of rivalry between the two institutions in 1813.

Here again the subjects are so related, I treat them as one.

p. 217—5th minute book—Board meeting 28th 6th mo. 1781.

The managers of the House of Employment & The Overseers of the Poor, thru John Cummings, Steward of said house, request that Paupers may be occasionally admitted into the Hospital as pay Patients, at the rate of a Spanish Mill'd Dollar per week—to which the board agreed at the rate of a dollar & one third, said specie.

p. 324—6th minute book—meeting of 28th 2 mo. 1791—suit having been entered, a verdict was secured for "one thousand and fourteen pounds due to the 24th of February 1790" for care of patients from the Almshouse.

p. 431—7th minute book—12th mo. 19th 1801.

The Committee appointed to prepare proposals to be offered to the Managers of the Alms House for the Board of pay patients report—That they have carefully examined the household expences and find that in 1800 the weekly cost of a patient in the Pennsylvania Hospital was 269 and in 1801 was 253 cents; the average of those two years was 261 cents p. week. Considering that the price of provisions and other necessary articles of living will probably be reduced in the next year on account of the late peace between England and France etc. and that a further sum will probably be saved by admitting a larger number of patients inasmuch as wages, etc. will not be increased in the same ratio as patients are multiplied, your committee think it will be safe to lower the terms of admission to the Guardians of the Poor and therefore they submit to the board the propriety of adopting the following resolutions:—1st Resolved, that the Managers of the Hospital will take from the Managers of the Alms House all such pay patients as the Hospital physicians consider was proper cases to be received therein at 225 cents p. week. 2nd—Resolved, that all their pay patients who are now in the house shall be charged at the same price. 3rd—Resolved, that the accounts shall be settled at the end of every 3 months. 4th—Resolved, that if the foregoing proposals are not agreed to, the terms of admission shall not be altered from three dollars a week until further order is taken thereon. The Committee's report being considered is approved and they are requested to furnish the managers of the Alms House with a copy of the foregoing resolutions which the board will confirm—provided the physicians of the Hospital will agree to them and provided the number to be sent to the Hospital shall not at any time exceed what in the opinion of the Managers the house will conveniently and comfortably accomodate.

p. 433—7th minute book—meeting of 1st mo. 12, 1802—The Almshouse Board did not accept the offer they suggested the Pennsylvania Board adopt this resolution—

> Resolved that the Managers of the Pennsylvania Hospital will take from the Managers of the Alms House, all their lunatics and such other pay patients as may be considered curable cases and proper for admission into the said hospital (agreeably to its rules) at 225 cents p. week for each of them for one year. . . . The Almshouse Committee also propose to the Managers of the Pennsylvania Hospital that they shall cause to be attended all their patients who may be in the Almshouse by the Hospital physicians, gratis; and that they shall be supplied with medicines except liquors at the expense of the Hospital.

The Hospital Board agreed to these changes (p. 434—7th minute book) but the Almshouse Board decided not to enter into the agreement (p. 435.)

In 1815 (p. 241—8th minute book) the medical students of the Pennsylvania Hospital were invited to attend the surgical operations which may hereafter be performed in this House (the almshouse.)

Today, professional men hold appointments on the staff of the Pennsylvania Hospital and on that of the Philadelphia General Hospital, paralleling a like condition when in the early days the outstanding men of the times held appointments on the Pennsylvania Hospital staff and were also attached to the Almshouse, probably for the same reason that today any institution having an infirmary for the care of its own people has a physician on call.

To interpret these bits of history correctly, we must consider them in relation to the general economic and political conditions of the period. Viewed in this light, I am much impressed with the thought that the period between 1781 and 1815 possibly marks the emergence of the bona fide Philadelphia Hospital from the Almshouse Infirmary. The minutes above quoted constitute a very small portion of a voluminous correspondence between the almshouse and the hospital boards on the subject of taking patients from the almshouse into the hospital. The amounts of money involved, at the very low weekly rates, indicate a large number of these patients. We know from history in general that the city was growing at the time, and economic conditions were difficult and uncertain following the Revolutionary War. The urge toward civic growth and the inherent reluctance of the individual to accept change, probably combined to exert uncomfortable pressure on the almshouse board, resulting in the "hostile attitude" which Dr. Fay states they showed toward the rapidly developing medical profession. They could not escape the need for greater medical facilities than their infirmary offered, but—close at hand was a well established hospital—it would be easier, financially and administratively, to establish relationships which eventually could lead to amalgamation, than to develop a hospital department of their own, but the hospital managers did not take kindly to dictation. They had started out to achieve a certain object and were not any more inclined to change that objective than the almshouse managers were.

10. p. 802—reference to library.

The Pennsylvania Hospital medical library claims to be the first public medical library in the United States, having been founded in the following manner, as shown by the minute books:—

p. 314—2nd minute book—27th 7 mo. 1762—

> William Logan lately returned from London attended the Board with a Book intituled "An Experimental History of the Materia Medica by Wm. Lewis F R S" lately published in London being a Present to the Hospital by Doc$^{r}$ John Fothergill for the Benefitt of the Young Students in Physic who may attend under the Direction of the Physicians w$^{ch}$ is kindly accepted by the Managers as an additional Mark of the Doctor's Regard to this Institution and W. Logan is requested to acquaint him w$^{th}$ our grateful Acceptance thereof.

p. 378—2nd minute book—31st 5th mo. 1763—The Physicians agree that students receiving ward instruction should pay a fee and these fees should be applied

> to the founding a Medical Library in the said Hospital which we judge will tend greatly to the Advantage of the Pupils & the Honour of the Institution.

The first catalogue of the library was issued in 1790—listing 528 volumes. The catalogue of 1837 showed 7300 volumes and in 1856 the number had grown to 10,500. While our library contains many rare and valuable works on medicine and natural history and has grown by several thousand volumes since the 1856 catalog, it has not maintained its activity since the establishment of the splendid library of the College of Physicians in Philadelphia.

11. p. 804—reference to members of the staff.

Morgan, Shippen, Jr., Kuhn, and Rush, all practiced and taught in the wards of the Pennsylvania Hospital, in the archives of which are to be found many interesting references to, and documents signed by, them.

Interested members of the profession and students of history are cordially invited to go through the historic section of the Pennsylvania Hospital.

Philadelphia JOHN N. HATFIELD.

# EDITORIALS


## SURGERY, GYNECOLOGY AND OBSTETRICS

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JULY, 1934


## OBSTETRICAL ANALGESIA AND ANÆSTHESIA

IN no country have methods for the relief of the pain of labor or parturition been so extensively employed or so widely discussed both in medical journals and in lay magazines as in the United States. For purposes of clarity, it is proper to define the terms ordinarily used to describe various phases of relief of pain in obstetrics. The term "amnesia" indicates forgetfulness of pain, "analgesia" commonly refers to dulling the sense of pain, and "anæsthesia," to local or general insensibility to pain. It may be recalled, also, that more than one of these phases may be produced by the same drug or combination of drugs, depending on the dosage and method of administration.

The risk of anæsthesia, which is not great, falls chiefly on the mother. This risk is known to depend on her physical condition, on the anæsthetic agent, on the technique of its use, and on the degree of anæsthesia. Drugs used to produce amnesia and analgesia are seemingly more dangerous to the fetus. Apparently too little thought is sometimes given to the indirect effect of measures to relieve the pain of labor, as is apparent from the growth in the number of operative deliveries and the increased risk that accompanies these procedures. In a recent publication by the New York Academy of Medicine of the analysis of maternal deaths occurring in the city of New York in a period of 3 years, 1930 to 1932, inclusive, comment was made on the relationship of obstetrical anæsthesia to maternal and fetal mortality. In this report it was stated that the increased use of anæsthesia in labor was due to insistence of the lay public, that in addition to deaths directly attributable to anæsthesia the use of anæsthesia was a factor in keeping the maternal mortality rate in this country stationary during the previous decade, and that both the accessibility of anæsthesia and the lessening of expulsive power resulting from its use led to frequent operative deliveries to which many maternal and fetal deaths can be attributed. These investigators assumed that ether is the safest anæsthetic agent, if one must be given, and that a derivative of barbituric acid (pernocton), tribromethylalcohol (avertin), and spinal anæsthesia are entirely unsuitable for the parturient woman.

In favor of anæsthesia, as it has been used in the second stage of labor since the introduction of chloroform and ether and more recently of nitrous oxide and oxygen, it may be said that anæsthesia relieves the woman in labor of part or all of the severe pain of the second stage, that the relief of pain tends to prevent nervous fatigue and its attendant shock and that operative measures, when indicated, can be carried out more easily and

skillfully. Space does not permit consideration of the relative merits and dangers of ether, chloroform, and nitrous oxide and oxygen. It is generally conceded that the use of ether presents a combination of relative safety, cheapness, and simplicity of administration that as yet is unsurpassed. Chloroform possesses the last two requisites, but has a smaller margin of safety. Nitrous oxide and oxygen, a more expensive anæsthesia requiring greater skill in administration, can be administered under hospital conditions with a minimal amount of risk to mother and to child, if one always, "keeps the patient pink," as Lundy has concisely stated it. Spinal anæsthesia, which has been advocated for operative obstetrics because it produces loss of sensation and excellent relaxation of the cervix and pelvic floor, carries more risk for pregnant than for non-pregnant persons. Caudal, sacral, and parasacral anæsthesias are practically without risk, but they, as well as infiltration anæsthesia of the cervix and pelvic floor, can hardly come into general practice on account of the technical skill required in their administration.

Amnesia and analgesia were unfamiliar terms up to twenty years ago, although drugs such as morphine, chloral, paraldehyde, and alcoholic beverages had been used as analgesics. At that time, the administration of morphine and scopolamine during labor, popularly known as "twilight sleep," following the report by Koenig and Gauss, was tried extensively, but this method of producing amnesia and analgesia has been discontinued except by a few skilled obstetricians who have special hospital arrangements and trained attendants. The statement that the routine use of morphine during labor is followed by a higher incidence of fetal asphyxia, as attested by Baer, Piper, Plass, Irving and by others, has not been successfully contradicted. Maxwell stated of the use of scopolamine that one in four patients is refractory to the drug, and that it prolongs the second stage of labor leading to increased operative interference.

Other analgesic agents have appeared, including avertin, pernocton, other derivatives of barbituric acid, and the Gwathmey method of colonic ether-oil analgesia. Avertin, which must be used rectally, and pernocton and the barbituric acid derivatives, when used intravenously, have the common fault that patients may be susceptible to them; this cannot be guarded against, owing to the rapid and uncontrolled effect of rectal absorption and of intravenous medication and the narrow margin of safety when actual anæsthesia is produced.

Gwathmey oil-ether colonic analgesia has been rather widely used. Tovell lists as possible complications: rectal irritation (which need not occur if there is no rectal disease or if it is properly given), arrested labor, ether shock, and asphyxia neonatorum. To these may be added the risk of tissue slough if the accompanying solution of magnesium sulphate fails to be injected into the muscle, together with the increased incidence of instrumental delivery. It has distinct value in prolonged labors, especially in primiparæ with the occiput in the posterior position. The method is inexpensive, and can be employed either in the home or in the hospital by those who are trained to its use.

Irving and his coworkers have recently published the results of the use of eight different combinations of hypnotics in the production of anæsthesia during labor. The drugs used were: (1) an opium derivative (pantopon) and scopolamine, (2) pantopon and rectal ether, (3) pernocton, (4) sodium amytal and scopolamine, (5) pentobarbital sodium and scopolamine, (6) sodium amytal and rectal ether, (7) pentobarbital sodium and

rectal ether, and (8) pentobarbital sodium and paraldehyde. Each combination was administered in a dosage aimed to produce complete amnesia in eight series, of 100 patients each, in which no major abnormality, on admission to the hospital was presented.

In commenting on the effects of these drugs, the authors advised against the use of morphine and its derivatives during labor, as it distinctly delayed the initial respiration of the child. There was delayed respiration varying from 35 per cent in the group of infants whose mothers had received pentobarbital sodium and ether by rectum to 67 per cent in those infants whose mothers had received pantopon and scopolamine. In the out-patient department, in a control series of cases in which delivery was without anæsthesia, only 1.9 per cent of infants did not breathe spontaneously at birth. The delayed respiration in the total series of 860 babies, however, did not increase the stillbirth rate, which was only 0.93 per cent.

In conclusion, Irving and his coworkers stated that they believed the combination of pentobarbital sodium and scopolamine was the most effective method; 86 per cent of the patients who received these drugs had complete amnesia, 83 per cent did not exhibit excitement, and 63 per cent of the infants breathed immediately on birth. In this group, however, the incidence of operative deliveries was 47 per cent in primiparæ and 30 per cent in multiparæ. Independently, Moore had reached a similar conclusion regarding the use of pentobarbital sodium and scopolamine to produce analgesia in labor.

If an analgesic is to be used, it is suggested that one of the safest forms of analgesia known at present is that obtained by the oral administration of sodium amytal or pentobarbital sodium, although the latter seems preferable because of the lesser incidence of excitement. These drugs should be given by mouth, not intravenously (except in eclampsia), and should be given in repeated doses, suiting the total dosage to the needs of the patient. The first dose of 1½ to 3 grains (0.09 to 0.20 gram) of pentobarbital sodium may be given when the cervix is dilated about 3 centimeters, depending on the frequency of the pains and the degree of the patient's discomfort. A dose of 1½ grains of this drug is repeated every 30 to 60 minutes, depending on the complaint of the patient. Although treatment is individualized in each case, the average total dose of pentobarbital sodium in a given case is from 6 to 7½ grains (0.40 to 0.42 gram) or more. This may be supplemented by colonic oil-ether in cases of protracted labor, or when the pentobarbital sodium does not control the pain. Reasonable relief of pain rather than complete amnesia is desired, so that co-operation of the patient will be retained in the second stage. Morphine need be used rarely, and then early in labor and in combination with atropine rather than with magnesium sulphate. A nurse or trained attendant should be in constant attendance. A mixture of nitrous oxide and oxygen, perhaps supplemented by ethylene or ether, will adequately control the pains of the second stage and during any necessary repair. Sacral block may be used in complicated cases, such as heart disease or tuberculosis.

The ideal analgesia or anæsthesia should be safe for both mother and child and should not interfere with the efficiency of uterine contractions or the patient's co-operation, so as to decrease to any appreciable extent the number of spontaneous deliveries. As yet, no method of relief of pain in labor has been discovered which entirely fulfills this requirement.

As practitioners of obstetrics who wish to relieve unnecessary pain during labor should

we not ask ourselves whether complete amnesia or anæsthesia is desirable if this state definitely increases the number of operative deliveries? One may point out many obstetricians competent to perform delivery by means of forceps with a minimal amount of risk to mother and child. Yet the cold facts remain that, by and large, the increased use of operative means of delivery is followed by increased morbidity and mortality for mother and child.

In this country the demand for relief of pain by the parturient woman is so insistent that the successful practitioner of obstetrics must use, in most labors, some means for its relief. Is it not then incumbent on us to acquaint the laity with the evident fact that there is a fairly definite ratio between the degree of relief of pain during labor and the increase of operative deliveries? ROBERT D. MUSSEY.

## WATER BALANCE IN SURGERY PATIENTS[1]

SURGEONS in general realize the great importance of maintaining an adequate supply of water to their patients, without which normal chemical and physiological processes cannot go on. The healthy individual maintains his water balance by responding to hunger and thirst, but the surgical patient often because of his disease or operation cannot obtain fluids through normal channels. The fluid intake is then governed by the surgeon.

Water becomes available to the body largely by the ingestion of food and drink and is excreted through the kidneys as urine, from the gastro-intestinal tract in the stool, and from the lungs and skin. This last output is an important part of the heat dissipating mechanism of the body. It is visible when sweating occurs but generally is an insensible process. For this reason it has seldom been considered in calculations of water requirements although the volume of water involved may be greater than the urinary output.

Studies of patients during operation and in a four-hour recovery period show that on an average one liter of fluid is lost during this time, about 70 per cent of which is lost through the skin and lungs. In certain prolonged operations, the water thus lost actually amounted to over 2 liters. This loss can be lessened greatly by diminishing the blankets placed in the ether bed. Similar studies over several days' time on a series of surgical patients show that the insensible loss of water for the simple, uncomplicated case, varies from 1,000 to 1,500 cubic centimeters of water, daily. This volume corresponds approximately to that of a normal individual in the same environment. Studies on surgical patients with infection, fever, and hyperthyroidism, showed that these factors keep the insensible loss at a level much higher than in the normal person, in general closely approximating 2 liters per day. This figure furnishes a sufficiently accurate estimate of the daily insensible water loss of the sick surgical patient. The visible fluid losses from the gastro-intestinal tract by vomiting, diarrhœa, and from the kidneys are easily ascertainable. The summation of the total of these visible losses and the 2 liter insensible factor gives the total water losses for the period.

Water will be utilized by the body for the dissipation of heat at the expense of water needed for the excretion of waste material through the kidneys. The kidneys do not have the privilege of taking a share of the supply of available water, but function with the water left after all other physiological and pathological water needs have been cared for. The volume of urine output is therefore the

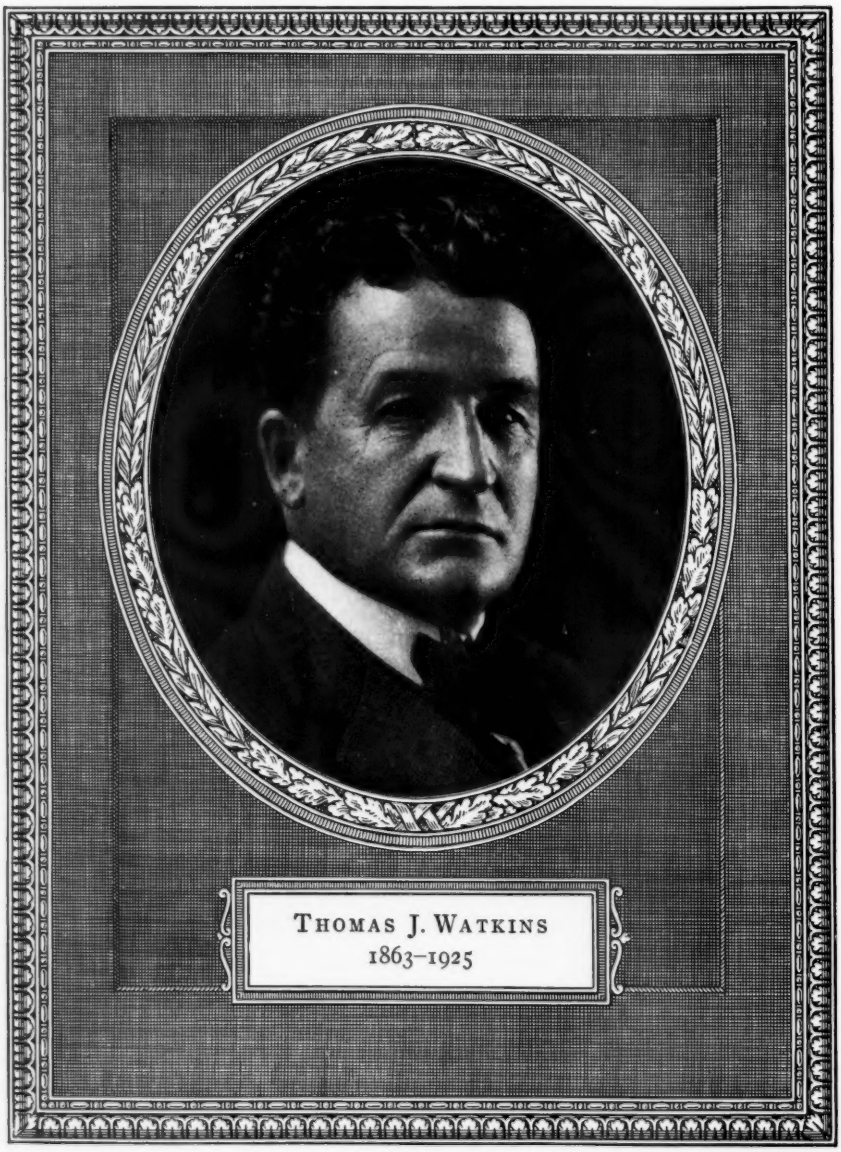
[1] From the Department of Surgery, University of Michigan.

best indication as to the sufficiency of the water supply. For the sick surgical patient it should be about 1,500 cubic centimeters daily. A low urinary output by a seriously ill patient is frequently thought to be due to a suppression of kidney function by toxins. There are many causes of anuria but none of them should be considered until the water exchange of the few previous days has been checked over and dehydration as the etiological factor eliminated.

The choice of fluid to be given should depend entirely upon the material to be replaced. The chief body fluid electrolytes are sodium and chloride ions. Abnormal losses of fluids from the gastro-intestinal tract always carry away appreciable amounts of these substances, as do also massive inflammatory exudates. Sodium chloride should then be replaced with the water. Many times, however, fluids are given simply to prevent dehydration, the patient, because of the nature of the disease or operation, being unable to ingest a sufficient amount of fluids by mouth. A five per cent. glucose solution, which is nearly isotonic, is preferable in these cases because it supplies the needed water, furnishes some food, and prevents ketosis.

Parenteral fluids should be administered in quantities calculated to meet the requirements of the individual, thus avoiding the dangers of volumes too small or the discomforts of those too large.

FREDERICK A. COLLER.



THOMAS J. WATKINS
1863–1925

UNIV OF MIAMI

# MASTER SURGEONS OF AMERICA

## THOMAS JAMES WATKINS

NINE years have elapsed since the death of Thomas James Watkins. Now that time has partially assuaged the grief and sense of personal loss which his friends experienced at his sudden demise, the intrinsic greatness of this man stands out more clearly. As a gynecologist, teacher, and contributor to the advancement of the gynecology of his period, he is destined always to have a prominent place in its annals.

He was born on July 6, 1863, near Utica, New York, and died on April 1, 1925. His boyhood days were spent on a farm. In the days of reconstruction following the Civil War, his lot was an unusually severe one. The work was hard and the pleasures and privileges few. From such humble beginnings have sprung many other great Americans who have mastered their destinies. He attended the local schools when circumstances permitted. Later he attended Holland Patent Academy and Adams Collegiate Institute. At some early period there came to him the ambition to study medicine, for he entered the University of Michigan at the age of 17, and spent three years there (1880-1883). He graduated, however, from Bellevue Hospital Medical School in 1886. Evidently aspiring to better preparation, he served interneships in the Utica (New York) City Hospital, in St. Peter's Hospital in Brooklyn, and in the Woman's Hospital in New York. In the Woman's Hospital he came under the direction of Thomas Addis Emmet, that great pioneer in plastic surgery which constituted so great a part of the gynecological surgery of that period.

Dr. Watkins moved to Chicago in 1889 and soon afterward joined the staff of Northwestern University Medical School. He continued in close association with this school until his death, at which time he was chief of the department of gynecology. He was an exceptional teacher; he not only taught his students sound principles, but was able to convey to them a part of his own earnestness and enthusiasm. He spared no time or effort in being helpful to younger men—one of his finest attributes—and exerted a marked influence over the lives of his associates, many of whom owe their success in no small measure to him. He became a Fellow of the American Gynecological Society in 1896 and was its president in 1916, a distinction conferred only on men of exceptional and genuine merit.

From the beginning (1889) Dr. Watkins contributed generously to gynecological literature. There was a soundness in his opinion that soon won for him a place among its most dependable authors. He wrote and published, in all, some 116 papers. Taken together they would have made a fairly complete list of the subjects that were interesting to the clinician at the time they appeared. In addition to these we find his name appearing frequently in the discussions at scientific meetings. Whenever he spoke it was always to add something of soundness and good judgment. His published writings reflected his deep interest in clinical gynecology. With a respectful regard for the opinions of others, and for accepted formulas and procedures, he did not hesitate to express a contrary opinion whenever the ideas being advanced did not conform to his own experience. One listened or read with a feeling that his conclusions were those of a keen, clinical observer. He helped materially to establish an attitude of conservatism in the treatment of abortion and puerperal infections. His simple treatment of the infected abdominal wound shortened healing and prevented a protracted convalescence. He wrote of extra-uterine pregnancy, the management of pelvic infections, gonorrhœa in women, fibroids, ovarian tumors, dysmenorrhœa, ovulation and menstruation as postoperative considerations, prophylaxis of uterine cancer, and innumerable other subjects of interest to the profession. In fact, there was nothing in clinical gynecology that did not interest him, and few subjects escaped his pen. Perhaps his most valuable contributions were those dealing with gynecological plastic surgery, which purposed to transmit to others his own original ideas in this field in which he was considered a genius. Among these were some five or six articles on the transposition operation.

As an operator Dr. Watkins was courageous, calm, ingenious, dexterous, and soft of hand and touch. He brought to the operating table a fine sense of mechanics and a clear, judicious mind that meant success where others might have failed. His skill was perhaps best seen in his plastic work. He sensed quickly the problem that was before him in all its details, made his incisions and found his lines of cleavage with unerring accuracy and little loss of blood, and placed his sutures perfectly with a fine sense of stress and strain; thus, when all was done the parts were beautifully restored and free from tension. In doing these operations he depended much on the scissors, in the use of which he was extremely expert. With every master surgeon there is withal something of the spirit of the pioneer. In his vaginal operations and more particularly in those of the anterior vaginal wall, including the urethra and bladder, he contrived many useful procedures. Contemporaneously with Duehrssen and Schauta, but independently, he conceived and developed the transposition operation later commonly called the interposition operation, and known also in America as the "Watkins operation." It was a clever application of mechanical principles. Through an anterior, vaginal incision he partially freed the bladder from the vagina and uterus, entered

the abdomen anterior to the uterus, brought the fundus forward and placed and sutured it snugly between the bladder and anterior vaginal wall. It gave permanent relief to those women beyond the menopause suffering from vesico-uterine prolapse. The procedure has found a permanent place in gynecological surgery. Moreover, he devised and developed other operations for uterine prolapse in younger women and under a variety of conditions. Uterine prolapse was formerly one of the most difficult problems to the gynecologist. He did certainly as much as any other man of his day to enable one to attack these cases with confidence and with satisfactory results.

This is an account of a master surgeon, and as such is intended to portray his scientific attainments. However, no one of us who knew Dr. Watkins will ever be able to think of him from this standpoint alone. His was a remarkable personality which won for him the admiration and the devotion of innumerable friends. He was gentle of manner, and sincere. He possessed that sense of honor characteristic of the finest men. In him were marvelously combined force and charm. A certain seriousness of mind was relieved by a rare sense of humor that made him ever a delightful companion. His stories, his smile, his little mannerisms—who can forget them? One does not know which to admire most, the master surgeon or the man.

RICHARD R. SMITH.

# EARLY AMERICAN HOSPITALS

## THE EARLY DAYS OF THE MONTREAL GENERAL HOSPITAL

H. E. MacDERMOT, M.D., F.R.C.P. (C.), MONTREAL, CANADA

THE Montreal General Hospital is now in its 113th year of existence, which enables it to claim an antiquity that is respectable (but not any more remarkable than that) among the hospitals of North America. It has, on the other hand, a history of clinical teaching which suffers from no such mediocrity, as it antedates by very many years that of any other hospital on this continent.

When the institution began its work in 1819 there was only one other hospital in the city, the Hôtel Dieu, with its fine record dating back to 1644.[1] But the Hôtel Dieu was small, and Montreal at the opening of the 19th century was beginning to be sharply afflicted with its still persistent growing pains. The city was also a natural settling basin for the immigrants who, after the Napoleonic wars, came across the Atlantic in such streams; and immigrants meant poor people, desperately poor in most cases, and often suffering from typhus, or from typhoid fever, or cholera.

The first "quickening" of the hospital may be traced in the work of the Female Benevolent Society of Montreal, which had been formed in 1816 to deal with the destitution in the town. Among the activities of this society was the opening, in 1818, of a small hospital of four beds, appropriately and pleasantly designated the "House of Recovery." In 1819 the work of this now indispensable institution was taken over by a committee of business men, who thereupon put their hands to a plough which has been mainly guided by business men ever since. They bought a house in another part of the city—on Craig Street—with room for 24 patients, the bedding being supplied by the military authorities from disused army stores.

It was now called the Montreal General Hospital, and had an attending physician, Dr. Blackwood, a retired army surgeon. The medical work had so far been done by volunteers, whom we find being thanked in the newspaper (the *Montreal Gazette*) by Mrs. Gibb, directress of the Benevolent Society. She begged leave in the name of that institution

> to return its sincere thanks to the several gentlemen of the Faculty for the gratuitous advice and assistance which they have cheerfully and promptly afforded. Many distressed objects have been relieved by their timely professional skill who have no other means of expressing their gratitude than by this public acknowledgment.

The "gentlemen of the Faculty" were to continue giving gratuitous assistance for a much longer time than any of them suspected, and surely they have never been thanked more graciously than in this dignified but thoroughly sincere acknowledgment.

But the hospital had yet to root itself permanently. This it did in 1822 when it settled down on the site on Dorchester Street, which it has occupied ever since. The cornerstone of the new building had been laid with great ceremony on July 1, 1821.[2] Three men may be mentioned specially among the founders: the Hon. John Richardson, William McGillivray, and Samuel Gerrard. It was they who bought the land, which was then a nursery garden. Many others, of course, contributed to the building, but, in the way buildings have, it cost nearly double the original estimate. The debt was paid off the next year by Mr. Richardson. If the hospital were to be called by any other title it would be hard to find a name it should more appropriately perpetuate than that of John Richardson. The next best thing was the building, as a memorial to him, of the east or Richardson wing.[3]

In spite of the present dense surrounding city undergrowth, it may still be realized that the hospital stands on a considerable ridge of land, and that originally the site may well have presented the features of salubrity and open country for which it was selected. In this neighborhood

[1] An institution called the Hôpital Général de Montréal was founded in 1694, but it was an almshouse and school for teachers rather than a hospital. It ceased to function in 1719.

[2] This is the year of incorporation, and is considered as its first year.

[3] The hospital has always been dependent on the beneficence of individuals. To single out names from these is therefore an invidious task, but there is one family which has unique associations with the hospital, that of the Molsons. The hospital charter was applied for by the Hon. Wm. Molson in 1821, and he later became its President. Four of his descendants have since occupied the position, the tradition being carried on at present (1934) by Colonel Herbert Molson.

Fig. 1. The hospital in about its fifteenth year. Viewed from behind. Considerable foreshortening in relation to Mount Royal. (From *Hochelaga Depicta*, 1839).

there had been in the French régime, a fort, the Redoute de l'Enfant Jésus, part of the outer defences of the town.

The original hospital plans called for a central building of two stories, with basement and attic, 76 by 40 feet, and a capacity of 72 patients. As time and circumstance allowed, two wings were to be added, each with a further capacity of 72, so that the whole would form a very compact and serviceable establishment. Circumstance was duly obliging, the east or Richardson wing being added in 1832 and the west in 1848, as a memorial to Chief Justice Reid, by his widow. Other wings and enlargements and annexes have sprouted forth in the course of the century, such as were not dreamed of by the original architect, but the original plain, well-proportioned grey stone building

> Still stands serene, inviolate,
> Though millions have its pavement trod.

The original medical staff of the hospital consisted of J. Stephenson, William Robertson, A. F. Holmes, William Caldwell, and P. Loedel. With the exception of Loedel, they were all Edinburgh men. Caldwell had been an army surgeon, and had seen service in the Peninsular War. He was a man of resolute character. When the charter of the hospital was applied for in the local legislature in Quebec, it was opposed by a Mr. O'Sullivan in a speech as vehement as it was injudicious. Dr. Caldwell said what he thought of the speech in an indignant and forcible letter to a Montreal paper (the *Courant*). Perhaps he went a little too far, however, in adding a direct personal insult to Mr. O'Sullivan, who seems to have been no worse than an ordinarily hot headed, if bigoted, Irishman. At any rate, he showed that he had more than mere political spirit in immediately calling the doctor out.

The duel was fought at six o'clock on a Sunday morning near the Windmills, a ground close to the St. Lawrence—it had witnessed similar meetings before. As the combatants used pistols carrying ounce bullets, and exchanged five shots, we cannot misunderstand their intentions towards each other. The shooting was good enough to give Caldwell a shattered arm, and O'Sullivan a bullet through his chest, but both recovered and the charter was granted in due course.

It had been the intention of the medical board from the very first that teaching should be carried on in the hospital. This indeed had been one of the points attacked by Mr. O'Sullivan, with all the ardor of the half-baked politician's ignorance. In the autumn of 1824 a medical school, the Montreal Medical Institute, was opened in connection with the hospital, and 25 students were enrolled. This was the beginning of that long and unbroken tradition of teaching which has already been mentioned; and the feature which distinguished it from that done in other hospitals was that instruction was given at the bedside and in the ward. The school eventually became merged into the Faculty of Medicine of McGill University,

Fig. 2. The hospital as originally planned, finished in 1848 by the addition of the Reed wing.

but the use of the hospital for clinical teaching never ceased. Osler tells us[1]:

> When I began clinical work in 1870 the Montreal General Hospital was an old coccus and rat-ridden building, but with two valuable assets for the student—much acute disease, and a group of keen teachers. Pneumonia, phthisis, sepsis, and dysentery were rife. The "services" were not separated, and a man for three months looked after medical and surgical patients, jumbled together in the same wards. The physic of the men who were really surgeons was better than the surgery of the men who were really physicians, which is the best that can be said of a very bad arrangement.

Students have been from the beginning therefore an accepted part of the life of the institution, and it has always had by-laws governing their admission and behavior. Among the earliest of these is one directing "that the student should remove the hat while in the operating theater, both that he may not obstruct the view of others, and as a mark of respect."

The medical records of the hospital for the first 30 years or so consisted of quarterly reports. Typhus fever, up to the middle of the century, kept the beds constantly full; in 1848 sheds were built alongside the hospital to take care of 250 cases. Two matrons succumbed to the disease, and Dr. Caldwell survived his duel only to die of typhus ten years later. Dr. Loedel had predeceased him from the same disease.

Cholera was never admitted to the hospital as such, although in 1849 the Board of Health asked that cases of it be taken in, during the course of one of Montreal's periodical visitations of the disease. It did appear in the wards, however, from time to time; the first matron died of it. Fevers formed the bulk of the cases, including the still all-too-familiar typhoid. When a fever could not be diagnosed it was reported as a "synochus," a term we could still occasionally use, as it only means an obscure, long-continued fever.

Smallpox was treated at the hospital up to 1876, when the smallpox ward, a separate building annexed to the east wing, was finally closed. Osler was the last to be in charge of this ward, and contracted a mild attack of smallpox himself, in spite of repeated (though unsuccessful) vaccinations. He had only 16 pocks, according to his own scrupulous and characteristic record.

We have little to tell us of the methods of treatment. Bleeding was as much in vogue as anywhere else, and orders for bleeding basins are to be found in the records. Drugs occupied a much larger place than they now do, and alcoholic stimulants were freely given. Whiskey in the first year was ordered by the ten-gallon lot, and the minutes of the Committee of Management have many references to the supplies of liquor. Discrimination was exercised, as one entry records the Committee "sampling" brandy and port wine before ordering a hogshead of each. The late Dr. F. J. Shepherd said that even in his day every patient was given some stimulant, two bottles of ale or stout, four to eight ounces of port wine, or four ounces of whiskey or brandy. Once we find a protest at an excessive consumption of spirits, "the last pipe of wine being consumed in little more than three weeks." Dr. Shepherd suggests in his history of the hospital[2] that much of the wine was drunk by the nurses. It is probable that the con-

[1]The medical clinic. Brit. M. J., Jan. 3, 1914.

[2]Francis J. Shepherd, M.D. Origin & History of The Montreal General Hospital.

Fig. 3. The hospital in 1881, at the time of Osler's service there. Later the cupola was removed and a mansard roof added. (By courtesy of Dr. Maude Abbott.)

ditions of nursing were such as to make this not inexcusable: there was only one night nurse to look after several flats, and a patient might have to be strapped to his bed while the nurse went to the other wards. In the early reports numbers of patients are shown as being discharged for irregular conduct.

The wards were not lighted even by gas until 1841. Lanterns were used, or wicks floating in tumblers of oil. The governors in one place speak with grave concern (and very rightly so) of the dangerous habits among the patients of "lighting pipes and segars" at these lamps; and of the more serious trick they had of hiding their pipes in their straw beds for fear of detection. There must have been many times when groups of them in their nightcaps could have been found sitting round these flickering lights, smoking their "pipes and segars."

The momentum with which the hospital was so enthusiastically launched, has never been lost. Not that there have been no periods of depression and anxiety in its life. In 1827, for example, it was felt necessary to reduce the establishment to three wards, requiring but two nurses, one house and laundry maid, one cook and one manservant. In 1846, too, it was recommended "to close up as many wards as could be done with propriety, to diminish the expenses of the hospital to the lowest limits." And again, in 1850, it was urged "that no more wards be opened than was absolutely necessary to prevent contagion, on account of the low state of the funds of the hospital." Occasionally there is recorded the unusual and pleasing phenomenon of income exceeding expenditure, as in 1872 and for some years after. Alas, that was very long ago!

But the growth of the hospital to its present dimensions is a fair index of its unfailing vigor. Perhaps the more spectacular changes have been on the surgical side, as would be the case with any institution with a pre-Listerian existence. Dr. F. J. Shepherd was until quite recently (he died in 1929) a link with that period of septic darkness which preceded the Listerian dawn, and his active and retentive mind would recall it vividly. He had seen and been taught by the old surgeons who made a point of using well worn and well infected coats in which to operate, but who on the other hand, operated often with a speed and precision not seen nowadays. Lister's methods were introduced by Dr. Thos. Roddick, who studied under Lister in 1877 and brought back to Montreal a full equipment of dressings and steam sprays. Dr. Shepherd notes that "after the Listerian methods were introduced the man who looked after the instruments no longer attended the post-mortems."

It was, too, no small revolution of method that took place when Osler was put in charge of the autopsy room in 1875. From then on, postmortem material was made to play the important part that it deserved. Osler drew heavily on his multitudinous records, assembled here, for his textbook and various lectures.

The first X-ray apparatus in the hospital was installed in 1898; this was only 2 years after Roentgen's discovery. But the first X-ray taken in connection with the hospital had been in the

Fig. 4. Showing, from left to right, the Pathological Building, the new wing, and original buildings.

McGill Physics Department, in February, 1896, by Professor Cox, who at the request of Dr. Kirkpatrick, a member of the hospital staff, took a picture of a wounded leg. The occasion is interesting as being the first instance on this side of the Atlantic of the rays being used for clinical purposes. Incidentally, it was the first instance on record of their being accepted as medico-legal evidence, as the picture later was produced in court in connection with the case.

Some details of the management of the hospital may be of interest. As shown by the Visiting Book for 1823, it was the governors who first thought of having screens in the wards:

> We think it would be an improvement were a few movable screens of some cheap and light material made, so that they could be sliped in between the beds occasionally—such screens seem particularly wanted in the women's ward.

Nothing seems to have been done about it, however, and the next month another governor took it up:

> I reiterate the suggestion heretofore made of a further improvement which might materially add much to the relief and convenience of the sick, with little encrease of trouble at a trifling expense. As the Patients are now lodged, there are numbers in the same room at all times exposed to the view of each other. To some this may be a matter of indifference, but to others of more delicate mind or habit, and to any in certain states of feeling, to be perpetually exposed to the gaze of others, or to be compelled to see what is passing, may occasion no slight degree of painful sensation, and to these some greater degree of privacy might be a source of comfort and gratification, and so far of salutary influence.

The Committee of Management then replied decisively that

> They have consulted with the medical gentlemen in attendance, and they do not approve of the above plan, of supplying the wards with screens, as the free circulation of air would thereby be impeded.

The matter of slippers next engaged the attention of the Governors:

> We recommend that (if approved by the medical men) a few pairs of slippers (without quarter) be procured for the use of the Patients.

This was attended to, the Steward was requested to provide "three dozen half-made Beef Shoes to serve as slippers in the wards for the patients." There is also a recommendation "that a Sedan Chair be procured for the purpose of transporting patients from their respective wards to and from the Baths."

Nightcaps for the patients were part of the patients' wardrobe, as shown in the early lists of hospital stores. One other unusual item among the early purchases is that of "twelve spittoons." These were placed in the wards; later on a complaint appears regarding their misuse at night by the patients.

A few words only can be said about that most important aspect of hospital life, the nursing. At first the nurses were classed with the servants, the records giving full details regarding their wages and meals; the latter included:

> Tea and bread and butter for breakfast and supper, meat and soup for dinner, with seven gallons of beer per week. The quantity of butter shall not exceed six lbs. per week. The matron shall be allowed two pounds of butter per week.
>
> The wages shall be not more than five dollars a month.

Nursing as we think of it was a fairly late development. In Dr. Shepherd's words:

> There were few nurses and no training of nurses. At that time nurses were born not made, mostly of the "Sairey Gamp" variety, often good motherly women, but many were addicted to the bottle.

The first matron, Mrs. Stephenson, was appointed with the precautionary proviso *ad vitam aut ad culpam*, but as her salary was only thirty pounds per annum the precaution was probably superfluous. As a matter of fact she proved to be an excellent servant to the institution.

No serious attempt was made to improve the nursing situation till 1875, when four nurses were brought out from Miss Florence Nightingale's school at St. Thomas' Hospital, under a Miss Machin, who was a Canadian. For three years they did excellent work in the hospital and would probably have established a training school if circumstances had not brought about their resignation and return to England. A new era in nursing began with the appointment in 1890 of Miss Norah Livingstone, a graduate of the New York Hospital. Dr. Shepherd, with his usual forcefulness of expression, refers to her task of setting things to rights as "the cleaning out of the Augean stables." It may not have been quite as bad as that, but it was bad enough. More than doing this, however, she created something new, and that was a training school for nurses which was and is second to none on the continent.

Miss Livingstone was a woman of outstanding personality, and had a long term of service, 30 years. She not only attracted a very fine type of woman to the work, as so often one sees a strong character do, but she made her good material even better. To quote Dr. Shepherd once more:

> The fame of the school spread abroad and her nurses were sent to all parts of the country. Many became superintendents of nurses elsewhere. Many devoted themselves to public service, others to private work, some died and some got married. The success of the school was chiefly due to Miss Livingstone. She was a woman of infinite tact, had a strong sense of humour, was a good judge of character, and a strict disciplinarian. She could not put up with any gross breach of discipline and did not suffer fools gladly.

# THE SURGEON'S LIBRARY

## REVIEWS OF NEW BOOKS

THE six hundred page monograph entitled "The Physiological Effects of Radiant Energy"[1] by Henry Laurens, professor of physiology at the Tulane University School of Medicine is one of a series issued by the American Chemical Society. The editors of this series of monographs state that one of their purposes is to promote research in the branch of science covered by the monograph, by furnishing a well digested survey of the progress already made in that field and by pointing out directions in which investigation needs to be extended. This monograph admirably fulfils this purpose.

The medical profession agree upon the possibilities of radiant energy in the treatment of a few diseases, but realized that its mode of action is still unknown except in a few instances and that there is no accepted method of estimating the proper dosage. Therefore the need of further research is evident, and, by giving a review in detail of the more outstanding evidences of the physiological action of radiant energy, this volume should stimulate this research.

In view of the positive statements, that cannot be believed, but which are continually being made by the manufacturers of artificial ultraviolet lamps, it is an indication of the value of this book when the author states: "No doubt many readers will be annoyed at the inconclusiveness of some of the statements and arguments. In several of the divisions considerable work is still being done and in others much must still be done in order to clear up the contradictions that have arisen as a result of differences in manner of attack, and inattention to quantitative matters which would have rendered repetition possible." The author has avoided drawing conclusions in most instances, so that this work is a most valuable source book on the work that has been done in the physiological effects of radiant energy. The bibliography is extensive and complete. It is therefore an outstanding reference work on its subject, and will be invaluable to any one interested in the action of radiant energy. JOHN S. COULTER.

SURGICAL lesions of stomach and duodenum are discussed in J. Shelton Horsley's new book.[2] In the opening chapter embryology, anatomy, and physiology are covered. There is a good summary of laboratory anatomy which, however, lacks correlation with surgical procedures and relationships. The reviewer regards this section as seriously lacking because little more is presented than what we find in a general text on surgery.

The chapters covering diagnosis of gastric and duodenal ulcer and carcinoma are well done, with the exception that there is practically no discussion of the surgical pathology of ulcer. The occasional difficulty of finding or identifying small ulcers, and methods of exploration preliminary to decision as to operation are facts the student of gastric surgery needs, at times sorely.

There is a chapter on preliminary preparations, incisions and postoperative treatment; following, one on operations for pyloric stenosis, cardiospasm, etc. The remaining chapters are devoted finally to the technique of various gastric and duodenal operations, including pyloroplasty, gastro-enterostomy, various types of resection, excision, treatment of fistula and cholecystoduodenostomy.

The author leans to the conservative side in the treatment of duodenal ulcer—being opposed to resection for this lesion. In this stand he has many supporters, but he is inviting discussion in stating that of the two conservative measures for duodenal ulcer pyloroplasty is preferable to gastro-enterostomy, because in the event of failure re-operation is easier. Far more space and emphasis are given to the Billroth I resection than the Pólya, a procedure generally recognized as having a wider field of application and greater margin of safety.

The author's teaching of the fundamentals of gastric surgery is essentially sound, but lack of illustrated detail would make it difficult for the young or inexperienced surgeon to grasp details of operative technique. J. R. BUCHBINDER.

THE three Gehrmann lectures delivered by Dr Pusey at the University of Illinois in 1933 have been assembled in a single volume.[3] The titles of the three lectures are: "The Beginning of Syphilis," "The Development of Our Knowledge of Syphilis," and "The Epidemiology of Syphilis."

In the first lecture the author shows with very definite evidence that syphilis originated in the West Indies and was transmitted to Europe by the sailors of Columbus' first expedition. At the end of the fifteenth century an army organized by Charles VIII of France invaded Italy. Many of the soldiers were already infected with the disease, and from them it quickly spread over Italy and then to the rest of

[1] THE PHYSIOLOGICAL EFFECTS OF RADIANT ENERGY. By Henry Laurens, Ph.D. American Chemical Society Monograph Series. New York: The Chemical Catalog Company, Inc., 1933.

[2] SURGERY OF THE STOMACH AND DUODENUM. By J. Shelton Horsley, M.D., F.A.C.S., LL.D. St. Louis: The C. V. Mosby Compa ny, 1933.

[3] THE HISTORY AND EPIDEMIOLOGY OF SYPHILIS. The Gehrmann Lectures. University of Illinois. By Wm. Allen Pusey, A.M., M.D., LL.D. Springfield, Illinois, and Baltimore, Maryland: Charles C. Thomas, 1933.

continental Europe. In this chapter the author shows that through the studies of Ivan Bloch, Haustein and other investigators syphilis has been definitely proved to have had its inception in Europe with the return of Columbus' crew from the West Indies.

The second chapter is the clinical history of the development of our knowledge of syphilis from the time of Fracastor and Paracelsus to the present day. The first part of this chapter deals with the splendid work done by the earliest observers—splendid when one realizes the limitations of their basic knowledge and scientific appliances. The last half of the chapter is the dramatic story of our more recent developments.

The development of this knowledge is as Dr. Pusey says, a brilliant illustration of what medicine has been able to do in the short period, as history goes, of the last four hundred years, since men have put their minds intensively on the objective study of diseases and their rational explanation.

The last chapter on the "Epidemiology of Syphilis" is an interesting consideration of four factors: (1) the reservoir of infection; (2) the infecting organism, (3) the susceptible host, and (4) the means of transmission.

Dr. Pusey believes that 5 per cent is a fair estimate of the incidence of syphilis for the entire population. European statistics indicate that it is more frequent in European cities than American. Many statistics show it is to be more prevalent in urban than in rural districts. Quoting Dr. Parran, he says that the annual crop of new cases in the United States is 871,000. The author, however, believes that the disease is decreasing. The remainder of this chapter discusses the methods of transmission, the infecting organism, and the sanitary measures promulgated for the control of the infection.

This book is well worth reading; it is well written, printed on good paper, and well illustrated. It is an interesting story well told.

THE biological principles underlying the clinical, radiological, and histological diagnosis and perversions of growth and disease in the skeleton are presented in an unusually clear, sound, and readable manner, by Harris in his book[1] *Bone Growth in Health and Disease*. The origin of the dense, transverse lines of the diaphysis is described in detail. These lines are correlated with the onset and duration of nutritional and disease states both antenatal and postnatal. Excellent cuts showing pathological sections illustrative of the lines of arrested growth are numerous.

Part II is given to a consideration of bone growth in reference to deficiency diseases. The origin and growth of cartilage is carried through the stages of senescence, degeneration, and calcification of cartilage cells. The author considers the origin of the osteoblast from many angles and suggests that they originate from rejuvenated cartilage cells at the zone of epiphyseal growth. Growth disturbances occurring in rickets and scurvy are shown in extensive radiological and pathological studies supported by animal experimentation. Mitotic figures in epiphyseal cartilage are shown in specimens from small embryos and the growth of cartilage toward the epiphyseal line and toward the articular surfaces is illustrated. Perversions of cartilage growth in achondroplasia and fetal abnormalities are described in the author's clear manner.

The specific changes of bone growth in syphilis and tuberculosis are described. Chapters on growth and disease of the spine, age changes in the skull and costal cartilages are concise and informative.

As an authoritative and practical work dealing with the processes and defects of bone growth, this book has few rivals and is highly recommended to those interested in problems of bone growth in both health and disease. FREMONT A. CHANDLER.

THE monograph on *Nasal Accessory Sinuses*[2] is both a manual for the roentgenologist and a text book for the practicing clinician. In the five chapters and two hundred illustrations he has succeeded in giving us a clear conception not only of roentgenographic technique but clinical interpretation as well. Closer association between the rhinologist and roentgenologist is the keynote of the text, and the author points out many helpful points in this respect. He has added a great deal toward the anatomical study of the sinuses pointing out minute important points in the interpretation of films which should be of aid to the rhinologist. The plates are especially good and include both normal and pathological conditions. In general the book should be of value to both the rhinologist and the roentgenologist.

JOHN F. DELPH.

THE material for Schiller's study on granulosa cell tumors[3] was supplied by the Vienna gynecological university clinic. The older idea that these granulosa cell tumors arise from the mature follicular epithelium of the ovary is rejected in favor of the hypothesis that embryonic rests of the mesenchymal anlage of the ovary may undergo neoplastic changes. Thus a scale of different tumors may be produced from primitive, sarcoma-like structures to the highly differentiated forms which imitate the adult, epithelial granulosa cell of normal follicles.

The clinical characteristics of these tumors are discussed and the attempt is made to divide the whole group into sixteen benign and eight malignant tumors. The significance of a differential diagnosis from the carcinoma of the corpus uteri in postclimacteric hæmorrhages is emphasized and other cases

[1] BONE GROWTH IN HEALTH AND DISEASE; THE BIOLOGICAL PRINCIPLES UNDERLYING THE CLINICAL, RADIOLOGICAL, AND HISTOLOGICAL DIAGNOSIS OF PERVERSIONS OF GROWTH AND DISEASE IN THE SKELETON. By H. A. Harris, D.Sc. (Lond.), M.B., B.S. (Lond.), B.Sc. (Wales), M.R.C.S., M.R.C.P. London: Oxford University Press, 1933.

[2] ANNALS OF ROENTGENOLOGY; A SERIES OF MONOGRAPHIC ATLASES. Edited by James T. Case, M.D. Vol. XV—NASAL ACCESSORY SINUSES. By Frederick M. Law, M.D. New York: Paul B. Hoeber, Inc., 1933.

[3] PATHOLOGIE UND KLINIK DER GRANULOSAZELLTUMOREN. By Dr. Walter Schiller. Vienna: Wilhelm Maudrich, 1934.

are cited with phenomena which are produced by an abnormal hormone formation within the tumors, amenorrhœa, and masculation. Attempts failed to produce similar tumors artificially in mice by injections of mixtures of pregnancy urine and coal-tar solutions. Only in one mouse one tumor was found which resembled histologically a human, undifferentiated granulosa cell tumor.

This thorough histological and clinical study will be of interest mainly to the gynecologist. He may be induced by it to be less persistent in the general application of X-ray sterilization following removal of a unilateral granulosa cell tumor in young women —provided that he accepts the author's histological differentiation of the benign and malignant forms.

ARTHUR WEIL.

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## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

HOEBER'S SURGICAL MONOGRAPHS. ACUTE INTESTINAL OBSTRUCTION. By Monroe A. McIver, M.D. New York: Paul B. Hoeber, Inc., 1934.

THE HOSPITAL MANUAL OF OPERATION. By Warren P. Morrill, Ph.B., M.D. New York: Lakeside Publishing Company, 1934.

SPINAL ANESTHESIA; TECHNIC AND CLINICAL APPLICATION. By George Rudolph Vehrs, M.D. St. Louis: The C. V. Mosby Company, 1934.

ZUR BERECHNUNG DES STATISTISCHEN MITTLEREN FEHLERS (STANDARD ERROR); FORMELN UND TABELLEN, WELCHE DIE BESTIMMUNG DES IN DER WAHRSCHEINLICHKEITSRECHNUNG ANGEWANDTEN MITTLEREN FEHLERS ERLEICHTERN. By Dr. med. A. M. Ritala. Helsingfors, Finland, 1933.

MODERN DRUG ENCYCLOPEDIA AND THERAPEUTIC GUIDE. By Jacob Gutman, M.D., Phar.D., F.A.C.P. New York: Paul B. Hoeber, Inc., 1934.

GUIDE PRATIQUE D'ANESTHÉSIE ET D'ANALGÉSIE AU PROTOXYDE D'AZOTE OXYGÈNE. By M. Flexer-Lawton. Paris: G. Doin & Cie, 1934.

CHRONIC NASAL SINUSITIS AND ITS RELATION TO GENERAL MEDICINE (CHRONIC SINUSITIS AND SYSTEMIC SEPSIS). By Patrick Watson-Williams. With a Foreword by Sir Humphry Davy Rolleston, Bart., G.C.V.O., K.C.B. 2d ed. Baltimore: William Wood and Company, 1933.

ANNUAL REPRINT OF THE REPORTS OF THE COUNCIL ON PHARMACY AND CHEMISTRY OF THE AMERICAN MEDICAL ASSOCIATION FOR 1933 WITH THE COMMENTS THAT HAVE APPEARED IN THE JOURNAL. Chicago: American Medical Association, 1933.

NEW AND NONOFFICIAL REMEDIES, 1934; CONTAINING DESCRIPTIONS OF THE ARTICLES WHICH STAND ACCEPTED BY THE COUNCIL ON PHARMACY AND CHEMISTRY OF THE AMERICAN MEDICAL ASSOCIATION ON JANUARY 1, 1934. Chicago: American Medical Association, 1934.

RECENT ADVANCES IN SEX AND REPRODUCTIVE PHYSIOLOGY. By J. M. Robson, M.D., B.Sc.(Leeds), F.R.S.E. With Introduction by Professor F. A. E. Crew, M.D., D.Sc., F.R.S.E. Philadelphia: P. Blakiston's Son & Co. Inc., 1934.

DISEASES PECULIAR TO CIVILIZED MAN; CLINICAL MANAGEMENT AND SURGICAL TREATMENT. By George Crile, M.D. New York: The Macmillan Company, 1934.

OBSTETRIC MEDICINE; THE DIAGNOSIS AND MANAGEMENT OF THE COMMONER DISEASES IN RELATION TO PREGNANCY. Edited by Fred L. Adair, M.A., M.D., F.A.C.S., and Edward J. Stieglitz, M.S., M.D., F.A.C.P. Philadelphia: Lea & Febiger, 1934.

BIOLOGÍA Y PATOLOGÍA DE LA MUJER; TRATADO DE OBSTETRICIA Y GINECOLOGÍA. By Josef Halban and Ludwig Seitz. Tomo xiv. Madrid: Editorial Plus Ultra, 1934.

RADIOLOGIC EXPLORATION OF THE MUCOSA OF THE GASTRO-INTESTINAL TRACT. By The Cole Collaborators. Saint Paul and Minneapolis: The Bruce Publishing Company, 1934.

LIBRO DE ORO. In Memoriam, Prof. Dr. Julio Iribarne. Contributions by his associates and pupils in the Department of Clinical Gynecology. Buenos Aires, 1934.

THE PRINCIPLES OF GYNAECOLOGY; A TEXT-BOOK FOR STUDENTS AND PRACTITIONERS. By William Blair-Bell, B.S., M.D. (Lond.), F.R.C.S. (Eng.), F.C.O.G., Hon. F.A.C.S., Hon. LL.D. (Glasg.). 4th ed. Rev. with the assistance of M. M. Datnow, B.Ch. (Liverp.), F.R.C.S. (Edin.), M.C.O.G., and Arthur C. H. Bell, M.B., B.S. (Lond.), F.R.C.S. (Eng.), M.C.O.G. Baltimore: William Wood and Co., 1934.

THE CHEMISTRY OF THE HORMONES. By Benjamin Harrow, Ph.D., and Carl P. Sherwin, D.Sc., M.D., Dr.P.H. Baltimore: The Williams & Wilkins Company, 1934.

THE CYCLOPEDIA OF MEDICINE. George Morris Piersol, B.S., M.D., Editor-in-Chief, and Edward L. Bortz, A.B., M.D., Assistant Editor. Volumes viii and ix. Philadelphia: F. A. Davis Company, 1934.

MODERN CLINICAL SYPHILOLOGY; DIAGNOSIS—TREATMENT—CASE STUDIES. By John H. Stokes, M.D. 2d ed. Philadelphia and London: W. B. Saunders Company, 1934.

# AMERICAN COLLEGE OF SURGEONS

## REPORT OF THE MEDICAL SERVICE BOARD

ON July 15, 1933, on authorization of the Executive Committee of the Board of Regents of the American College of Surgeons, Dr. J. Bentley Squier, president, appointed a Medical Service Board to study the provision of more adequate medical service to the whole community. The Medical Service Board consists of Robert B. Greenough, Boston, chairman; Bowman C. Crowell, Chicago, secretary; G. Harvey Agnew, Toronto; Charles A. Dukes, Oakland; Franklin H. Martin, Chicago; C. Jeff Miller, New Orleans; Eugene H. Pool, New York; Arthur M. Shipley, Baltimore; J. Bentley Squier, New York; S. Marx White, Minneapolis.

On June 10, 1934, the Medical Service Board made a report to the Board of Regents of the College which was approved by that Board. The report is a statement of principles which should be observed in the development and conduct of prepayment plans for medical and hospital service, and does not propose any specific plan.

The Medical Service Board of the American College of Surgeons respectfully submits the following report to the Board of Regents:

1. The American College of Surgeons affirms its interest and its desire to co-operate with other agencies looking toward the provision of more adequate medical service to the whole community.

2. The College believes that it is the duty of the medical profession to assume leadership in this movement and to take control of all measures directed to this end.

3. Encouragement should be given to the trial of new methods of practice designed to meet these needs, and a careful evaluation of their success should be the duty of the medical profession before they are offered for general adoption. All such new and experimental methods of practice must be conducted strictly in accordance with the accepted code of ethics of the medical profession in order that the interests of the patient and the community may be protected.

4. The College recognizes for immediate study four groups of the population for whom more adequate medical service should be made available, as follows:

(a) The indigent.

(b) The uneducated and credulous members of the community.

(c) Those who because of limited resources are unable, unaided, to meet the costs of serious illness and hospitalization.

(d) Those living in remote districts where adequate medical service is not obtainable.

5. The care of the indigent sick should be a direct obligation upon the community and (unless otherwise compensated by intangible benefits such as staff and teaching appointments, opportunity and experience), physicians fulfilling this public service should receive remuneration.

6. The College should work in co-operation with other medical groups in order to dispel the ignorance and credulity of the public, and to bring the people to a proper realization of the protective and curative resources of modern medicine.

7. The American College of Surgeons recognizes that the periodic prepayment plan providing for the costs of medical care of illness and injury of individuals and of families of moderate means offers a reasonable expectation of providing them with more effective methods of securing adequate medical service.

A number of different plans for the organization of such services have been proposed, although few have been in operation long enough to permit definite conclusions in regard to their success. It is to be desired that these experiments be continued. Conditions differ to such a degree in different parts of the country that a specific plan which is practicable in one place may require modification of details in other communities. The varying restrictions imposed by present insurance laws in different states further complicate the problem.

Periodic prepayment plans providing for the costs of medical service may be divided into two classes: (A) Payment for medical service; (B) payment for hospitalization.

It is suggested that plans for the payment of hospitalization alone (Class B) without provision for payment for medical service, may be con-

sidered the first project to be undertaken in the average community.

The American College of Surgeons believes that certain general principles can and should be established, the observance of which will tend to obviate known difficulties and dangers which may threaten the success of these special forms of medical service. These principles are as follows:

(a) Periodic prepayment plans for medical service should be free from the intervention of commercial intermediary organizations operating for profit. After deduction of the clerical costs of operation of the fund and such accumulation of reserve as may be advisable in the interest of the contributors or may be legally imposed, the full amount paid by the contributors should be available for medical and hospital services.

(b) In the interest of the patient, the organization of plans for the periodic payment of medical and hospital costs must be under the control of the medical profession. The medical profession must act in concert with the hospitals and such other allied services as may be involved in the individual project, together with a group of citizens representative of the whole community and of industry who are interested in the successful operation of the plan.

(c) The principle of free choice of the physician and hospital by the patient must be assured to the end that the responsibility of the individual physician to the individual patient shall always be maintained. When hospitalization is required, this choice must of necessity be limited to the physicians and surgeons who hold appointments on the staffs of the hospitals participating in the plan or to those physicians and surgeons who are acceptable to the hospital. It is further recommended that only approved hospitals be admitted to participation in such a plan.

(d) The compensation of the physician and of the hospital should be estimated with due regard to the resources available in the periodic payment fund and should be based upon the specific services rendered.

(e) The organization and operation of any plan of this type must be free from any features not in accordance with the code of ethics of the medical profession which code has been established for the protection of the patient.

(f) The medical organizations participating in such a plan must assume the responsibility for the quality of service rendered.

8. Periodic prepayment plans for medical and hospital service should eliminate many of the conditions which have brought about the development of industrial contract practice. Until such plans have been more widely established certain general principles are here formulated with a view to the elimination of the commercial features of such forms of medical service.

(a) The Minimum Standard for Industrial Medicine and Traumatic Surgery of the American College of Surgeons should be accepted.

MINIMUM STANDARD FOR INDUSTRIAL MEDICINE AND TRAUMATIC SURGERY

1. That the industry shall have an organized medical department, or service, with competent medical staff, including consultants, and adequate emergency dispensary and hospital facilities and personnel to assure efficient care of the ill and injured.

2. That membership on the medical staff shall be restricted to physicians and surgeons who are (a) graduates of scientific medicine holding the degree of Doctor of Medicine, in good standing and licensed to practice in their respective states or provinces; (b) competent in the field of industrial medicine and traumatic surgery; (c) worthy in character and in matters of professional ethics, that in the latter connection, the practice of the division of fees under any guise whatsoever be prohibited.

3. That there shall be a system of accurate and complete records filed in an accessible manner—a complete record being one which includes identification data; cause of illness or injury; nature and extent of illness or injury; detailed description of physical findings; special examinations such as consultations, clinical laboratory and X-ray; tentative or provisional diagnosis; treatment; prognosis with estimated period of disability; progress of illness or injury; final diagnosis; condition on discharge; end-results, and such additional information as may be required by statute for Workmen's Compensation claims or for other purposes.

4. That all patients requiring hospitalization shall be sent to institutions approved by the American College of Surgeons.

5. That the medical department shall have general supervision over the sanitation of the plant and the health of all employees.

(b) Physicians and surgeons, qualified as in paragraph 2 of the above Minimum Standard, may properly be employed on a full time or a part time basis by industrial organizations to provide medical and surgical service for their employees, as follows:

i. To provide emergency service and first aid in injury or disease, and to provide adequate medical or surgical care for industrial injuries and diseases. Medical and surgical care of the families of employees, and of employees themselves, except for emergency and industrial injuries and diseases, should be provided by the industrial physician only in remote districts

where adequate medical service is not available.

ii. To provide pre-employment and periodic physical examinations.

iii. To study the hazards of the particular industry and to co-operate with other agencies in effecting such measures as may be needed for the prevention of injury and disease.

iv. To keep accurate records such as may be required by local Workmen's Compensation laws, and so complete as to serve for scientific investigation of industrial hazards with a view to their further prevention. These records are privileged communications, subject always to due process of law.

(c) The sale of a contract by an industrial organization to an individual physician or group of physicians for medical and/or hospital service for its employees encourages commercial competition and is to be condemned.

(d) Unethical practices in publicity, advertising, solicitation, and competition, either of a professional or of a financial nature, must be eliminated.

(e) The accepted code of ethics of the medical profession, which is designed to protect the best interests of the patient, should apply to industrial medical service as to all other forms of medical practice.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

WILLIAM D. HAGGARD, Nashville, *President* ROBERT B. GREENOUGH, Boston, *President-Elect*
FRANKLIN H. MARTIN, Chicago, *Director-General*
ARTHUR W. ALLEN, *Chairman;* ERNEST M. DALAND, *Secretary, Committee on Arrangements*

## PRELIMINARY PROGRAM FOR THE CLINICAL CONGRESS IN BOSTON

THE surgeons of Boston have organized under the leadership of a representative committee and are planning to provide for the Fellows of the College and their guests a broadly interesting program of operative clinics and demonstrations at the twenty-fourth annual Clinical Congress of the American College of Surgeons to be held in that city October 15–19. The Committee on Arrangements has been assured of the hearty co-operation of the clinicians at the three medical schools and more than thirty hospitals that will participate in the clinical program, and expects to provide a most complete showing of their clinical activities in all departments of surgery.

A preliminary program of operative clinics and demonstrations, as prepared by the Committee on Arrangements, is presented in the following pages. It will be noted that clinics at the hospitals are scheduled for the afternoon of Monday, October 15, beginning at 2 o'clock, and for the mornings and afternoons of each of the four following days. The program as published is in tentative form and is to be revised and amplified during the months preceding the Congress. The final program will be published from day to day during the Congress—a complete and accurately detailed program being posted in the form of bulletins at headquarters each afternoon for the succeeding day and issued in printed form the following morning. The Committee plans to include in the clinical program many special features, among them being: (1) Fracture clinics at which modern methods in the treatment of fractures will be demonstrated; (2) cancer clinics demonstrating the treatment of cancer by surgery, radium and X-ray; (3) clinics in traumatic surgery for the presentation of methods of rehabilitation of injured patients by surgery and physiotherapy.

A symposium on cancer, under the auspices of the College Committee on the Treatment of Malignant Diseases, will be presented on Wednesday afternoon in the ballroom of the Copley-Plaza Hotel. This will include further reports by clinicians from various parts of the country presenting additional statistics on the cure of cancer. Following these reports a series of papers on the treatment of cancer descriptive of methods of treatment will be presented including "Surgical Treatment of Cancer of the Stomach" by J. Shelton Horsley, M.D., Richmond, Va.; "Cancer of the Cervix Treated by Surgery and Irradiation" by George Gray Ward, M.D., New York; "Cancer of the Breast Treated by Surgery and Irradiation" by Stuart W. Harrington, M. D., Rochester, Minn.; "Cancer of the Lip Treated by Surgery and Irradiation" by Ellis Fischel, M.D., St. Louis.

A conference on fractures, under the auspices of the College Committee on the Treatment of Fractures, will be held in the ballroom of the Copley-Plaza Hotel on Tuesday afternoon, and a conference under the auspices of the Board on Industrial Medicine and Traumatic Surgery in the same room on Friday afternoon.

Surgical motion picture films, both sound and silent, will be exhibited daily in the Georgian Room at the Statler Hotel. Many new films will be shown. The showing of films demonstrating clinical features of interest has met with popular acceptance in recent years and will be continued at this session with an enlarged program.

Ether Day will be celebrated at the Massachusetts General Hospital on Tuesday with special exercises at 4 p.m. in the dome room of the old building of the hospital where ether was first administered for the production of surgical anæsthesia on October 16, 1846.

### EVENING MEETINGS

The Central Executive Committee has prepared programs for a series of five evening sessions, a tentative outline of which will be found in the following pages. At the presidential meeting on Monday evening, to be held in Symphony Hall, the president-elect, Dr. Robert B. Greenough, of Boston, will deliver his inaugural address. On that occasion a number of distinguished surgeons from abroad who will be in attendance at the Clinical Congress will be introduced. Among the visiting surgeons will be the following: Prof. John Fraser, Edinburgh, Scotland; Dr. Bethel Solomons, Dublin, Ireland; Sir Harold Gillies and Mr. A. Lawrence Abel, London, England; Mr. Harry Platt and Dr. William F. Shaw, Manchester, England; Dr. Alexander MacLennan, Glasgow, Scotland; Dr. Rafael Silva, Mexico City, Mexico; Prof. Josef Halban, Vienna, Austria. A feature of this session will be the John B. Murphy oration in surgery by Dr. Donald C. Balfour.

Sessions on Tuesday, Wednesday and Thursday evenings will be held in the ballroom of the Copley-Plaza Hotel at which eminent surgeons of the United States and Canada, together with visiting surgeons from foreign countries, will present papers on surgical subjects of timely importance.

The annual Convocation of the College will be held on Friday evening in Symphony Hall at which the 1934 class of candidates will be received into Fellowship in the College.

### OPHTHALMOLOGY AND OTOLARYNGOLOGY

The committee in charge of the section on surgery of the eye, ear, nose and throat has arranged a program of ophthalmological and otolaryngological clinics and demonstrations at the hospitals and medical schools. This will be found in the following pages, and in addition programs for a series of four sessions on Tuesday, Wednesday, Thursday and Friday afternoons in John Hancock Hall, located on St. James Avenue midway between the Statler and Copley-Plaza Hotels. At these sessions distinguished specialists will present papers on subjects of timely interest.

A symposium on "Diseases of the Œsophagus" will be presented on Thursday afternoon at 3:30 in the ballroom of the Copley-Plaza Hotel following the annual meeting. The program follows:

An X-ray Study on Lesions of the Œsophagus (statistical study with lantern slides). A. S. MacMillan.

Infection of the Œsophagus in Acute and Chronic Disease; Fibrosis of the Terminal Portion of the Œsophagus (Cardiospasm), Etiology and Treatment. Harris P. Mosher.

The Surgical Approach to the Œsophagus. Edward D. Churchill.

### ANNUAL HOSPITAL CONFERENCE

An interesting program of papers, round table conferences and practical demonstrations dealing with problems related to hospital efficiency is being prepared for the annual hospital conference, which opens with a session in the ballroom of the Copley-Plaza Hotel at 10 o'clock on Monday morning. The conference continues during the following three days with morning sessions at the Copley-Plaza Hotel and afternoon sessions, devoted to practical demonstrations, at several of the local hospitals.

It is planned to make this year's program of wide interest and practical character through a careful selection of subjects to be presented and discussed by surgeons and hospital executives. Particular emphasis will be directed toward professional standards and the vital problems related to medical and surgical economics.

A greatly increased interest on the part of surgeons in both the administrative and scientific phases of hospital work has been evidenced in recent years, and the program for this year's conference will be unique in providing for discussion of subjects of greatest interest to the three major hospital groups—medical, surgical and administrative.

### HEADQUARTERS

The Statler and Copley-Plaza Hotels will be utilized as headquarters for the Congress. At the former, the grand ballroom and adjoining assembly room together with other large rooms on the mezzanine floor have been reserved for the exclusive use of the Congress for registration and clinic ticket bureaus, bulletin boards, technical exhibition and executive offices. A scientific exhibit, which will be arranged by the local committee, is to be installed in the balcony of the ballroom. At the Copley-Plaza Hotel the grand ballroom will be utilized for evening scientific meetings, hospital conferences and other large gatherings daily.

The Technical Exhibition will be located in the ballroom and adjoining assembly room at the Statler Hotel. The registration and clinic ticket desk, together with the information bureau, will be located in these rooms in which will also be found the bulletin boards on which the daily clinical programs will be posted each afternoon. The leading manufacturers of surgical instruments, X-ray apparatus, operating room lights, hospital apparatus and supplies of all kinds, ligatures, dressings, pharmaceuticals and publishers of medical books will be represented in this Exhibition.

### RAILWAY RATES

We are assured that the railways of the United States and Canada will grant low rates for the Clinical Congress in Boston—approximately one and one-third fares for the round trip on the certificate plan. Applications for reduced fares are now pending before the various railway traffic associations. Persons from the west traveling through Chicago will find it to their advantage to buy round-trip tickets to Chicago at the special low rates in effect because of the Century of Progress Exposition in Chicago. It will then be necessary to purchase tickets to Boston in Chicago taking advantage of the certificate plan.

### ADVANCE REGISTRATION

The hospitals and medical schools of Boston afford accommodations for a large number of visiting surgeons, but to insure against overcrowding, attendance at the Congress will be limited to a number that can be comfortably accommodated at the clinics—the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories of the hospitals and medical schools to determine their capacity for visitors. It is expected, therefore, that those surgeons who wish to attend the Clinical Congress in Boston will register in advance.

Admittance to all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

### BOSTON HOTELS AND RATES

Boston hotels will provide ample facilities and there should be no difficulty in securing first-class accommodations. It is advisable, however, for those who expect to attend the Clinical Congress to reserve their accommodations as far in advance as possible. In addition to the headquarters hotels, the Statler and Copley-Plaza, there are a number of first-class hotels within walking distance of headquarters. The following list of hotels with their rates has been prepared by the local committee:

| | Minimum rates with bath | |
|---|---|---|
| | Single | Double |
| Bellevue, 21 Beacon Street | $3.00 | $5.00 |
| Bradford, 275 Tremont Street | 2.50 | 3.50 |
| Braemore, 464 Commonwealth Avenue | 3.00 | 4.00 |
| Brunswick, 520 Boylston Street | 2.50 | 4.00 |
| Buckminster, 645 Beacon Street | 2.00 | 3.50 |
| Canterbury, 14 Charlesgate West | 2.50 | 3.00 |
| Charlesgate, 535 Beacon Street | | 4.00 |
| Copley-Plaza, 138 St. James Avenue | 4.00 | 6.00 |
| Fensgate, 534 Beacon Street | 2.50 | 3.50 |
| Graylyn, 20 Charlesgate West | | 5.00 |
| Hemenway, 91 Westland Avenue | 2.50 | 3.50 |
| Kenmore, 490 Commonwealth Avenue | 3.00 | 4.50 |
| Lenox, Exeter Street | 2.50 | 3.50 |
| Lincolnshire, 20 Charles Street | 3.00 | 4.50 |
| Manger, North Station | 2.50 | 3.50 |
| Parker House, 60 School Street | 3.00 | 4.50 |
| Puritan, 390 Commonwealth Avenue | 3.50 | 5.00 |
| Ritz-Carlton, 15 Arlington Street | 4.00 | 7.00 |
| Sheraton, 91 Bay State Road | 3.00 | 4.00 |
| Somerset, 400 Commonwealth Avenue | 3.00 | 3.50 |
| Statler, Park Square | 3.50 | 5.00 |
| Touraine, 62 Boylston Street | 3.00 | 5.00 |
| Vendome, 160 Commonwealth Avenue | 2.50 | 4.00 |
| Victoria, 271 Dartmouth Street | 3.00 | 5.00 |
| Westminster, 124 St. James Avenue | 2.50 | 3.50 |

## COMMITTEE ON ARRANGEMENTS

EXECUTIVE COMMITTEE

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RICHARD CATTELL
HENRY D. CHADWICK
EDWARD D. CHURCHILL
HOWARD CLUTE
ROBERT C. COCHRANE
E. GRANVILLE CRABTREE
ELLIOTT C. CUTLER
LINCOLN DAVIS
HILBERT F. DAY
AUGUSTUS W. DUDLEY
JOHN C. ECKELS
DAVID EDSALL
JACOB FINE
SETH FITCHET
NICHOLAS GALLAGHER
H. QUIMBY GALLUPE
HARRY H. GERMAIN
MAGNUS I. GREGERSON
OTTO J. HERMANN
GEORGE W. HOLMES
GILBERT HORRAX
HENRY T. HUTCHINS
CHARLES I. JOHNSON
STEPHEN JONES
GEORGE F. KEENAN
WILLIAM E. LADD
FRANK H. LAHEY
WALTER B. LANCASTER
HARRY J. LEE
EDWARD D. LEONARD
HALSEY B. LODER
MOSES H. LURIE
FRANCIS X. MAHONEY
PATRICK J. MAHONEY
HENRY C. MARBLE
LELAND S. MCKITTRICK
JOE V. MEIGS
CHARLES G. MIXTER
WILLIAM J. MIXTER
GORDON MORRISON
HARRIS P. MOSHER
DWIGHT O'HARA
ROBERT B. OSGOOD
ALONZO K. PAINE
FRANK A. PEMBERTON
LOUIS E. PHANEUF
WILLIAM C. QUINBY
LYMAN RICHARDS
GRACE E. ROCHFORD
HORATIO ROGERS
CHARLES L. SCUDDER
WILLIAM M. SHEDDEN
CHANNING C. SIMMONS
M. N. SMITH-PETERSEN
JOSEPH STANTON
A. WARREN STEARNS
HORACE P. STEVENS
LORING T. SWAIM
CHANNING SWAN
THEODORE L. TERRY
J. HERBERT WAITE
IRVING J. WALKER
SHIELDS WARREN
RALPH WIGGIN
CHARLES F. WILINSKY
PHILIP D. WILSON
EDWARD L. YOUNG, JR.

SUB-COMMITTEES

Clinical Program—RICHARD H. MILLER, Chairman; HORATIO ROGERS, Secretary.

Scientific Exhibits—ROBERT B. GREENOUGH, Chairman; CHANNING C. SIMMONS, Secretary.

Harvard Medical School Program—DAVID CHEEVER, Chairman; MAGNUS I. GREGERSON, Secretary.

Publicity—FREDERICK J. COTTON, Chairman; GORDON MORRISON, Secretary.

Entertainment of Foreign Guests—HORACE BINNEY, Chairman; WILLIAM M. SHEDDEN, Secretary.

Public Meeting—ALEXANDER BEGG, Chairman; DWIGHT O'HARA, Secretary.

Clinical Bulletin—FRANK OBER, Chairman.

Ophthalmology and Otolaryngology—GEORGE L. TOBEY, Chairman; LYMAN RICHARDS, Secretary, Otolaryngology; THEODORE L. TERRY, Secretary, Ophthalmology.

## SCIENTIFIC EXHIBITS

### AT HEADQUARTERS, STATLER HOTEL

FRACTURES. Demonstrating methods of treating fractures, under the auspices of the New England Fracture Committee of the American College of Surgeons.

PLASTIC SURGERY. An exhibit of models, photographs and diagrams, illustrating the different methods employed in plastic surgery and the results.

TRAUMATIC SURGERY. Diagrams, photographs and charts.

ORTHOPEDIC SURGERY. An exhibit of splints and other forms of orthopedic apparatus, together with charts and photographs.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH. An exhibit illustrating the activities of this department.

CANCER. An exhibit from the Palmer Memorial Hospital, Collis P. Huntington Memorial Hospital and the Pondville State Cancer Hospital. Lantern slides, charts and photographs illustrating cancer of the various organs of the body; the diagnosis and the results obtained by different forms of treatment. Also, an exhibit of specimens of cancer from many parts of the body.

OPHTHALMOLOGY. Charts and photographs illustrating melanotic sarcoma and other conditions of the eye.

PATHOLOGY. The specimens removed at operations from the various hospitals in the morning will be collected and placed on exhibition in artificially cooled showcases in the afternoon, in a room adjoining the Georgian Room. At 5 p.m. these specimens will be demonstrated in the Georgian Room by a projectoscope, the microscopic sections shown and the cases discussed.

### AT HOSPITALS AND MEDICAL INSTITUTIONS

HARVARD DENTAL SCHOOL. An exhibit of models, photographs and diagrams showing the restoration of extensive defects and deformities of the face and jaws by plastic surgery and dental prosthesis, including cases of soldiers wounded in the world war.

BOSTON MEDICAL LIBRARY. Exhibit of historical books on surgery and anatomy, and surgical medals. Historical pageant illustrating the development of surgery, Wednesday, October 17, John Ware Hall, 4 p.m.; presented by the students of Tufts College Medical School under the direction of Professor B. Spector. Exhibition of works of art by Massachusetts physicians under auspices of the Physicians Art Society.

MASSACHUSETTS GENERAL HOSPITAL. An exhibit in the Ether Dome relative to the first public demonstration of ether anæsthesia. Showing of moving picture "The First Public Demonstration of Ether Anæsthesia."

MASSACHUSETTS CHARITABLE EYE AND EAR INFIRMARY. Anatomical specimens and œsophageal instruments.

HARVARD MEDICAL SCHOOL, Warren Museum. Anatomy, anatomical specimens; pathology, pathological specimens.

## OPHTHALMOLOGY AND OTOLARYNGOLOGY—SCIENTIFIC SESSIONS

*Tuesday—John Hancock Hall, 2—Ophthalmology*

JOHN M. WHEELER, New York. Plastic ophthalmic surgery.

JONAS S. FRIEDENWALD, Baltimore. Slit lamp ophthalmoscopy.

CLARENCE KING, Cincinnati. Tuberculin in the treatment of ocular tuberculosis.

*Wednesday—John Hancock Hall, 2—Otolaryngology*

THOMAS E. CARMODY, Denver. Congenital deformities of the face and neck. Discussion opened by V. H. KAZANJIAN.

LOUIS H. CLERF, Philadelphia. Peroral endoscopy in otolaryngological practice.

SAMUEL J. CROWE, Baltimore. Meniere's symptom complex. Discussion opened by PHILIP MELTZER.

JOHN R. PAGE, New York. Acute infections of the middle ear and mastoid.

O. JASON DIXON, Kansas City. A departure in the management of acute mastoid disease or the advantages of conservative treatment in acute mastoid disease. Discussion opened by LYMAN RICHARDS.

GEORGE M. COATES, Philadelphia. Diagnosis of chronic infection of the tonsils in relation to indications for operation in cases of chronic focal infection.

WILLIAM V. MULLIN, Cleveland. Present status of infection of the upper respiratory tract in its relation to focal infection. Discussion opened by H. ARCHIBALD NISSEN.

EDWARD ZEIGELMAN, San Francisco. The clinical and surgical significance of the component cellular characteristics of the temporal bone, based upon a series of 100 cadaver and autopsy observations, lantern slide demonstration.

*Thursday—John Hancock Hall, 2—Ophthalmology*

LUTHER C. PETER, Philadelphia. How to treat disturbances of binocular vision by exercises; the use of the stereoscope in the treatment of heterophoria and heterotropia.

CLIFFORD B. WALKER, Los Angeles. The surgical treatment of separated retina.

C. N. SPRATT, Minneapolis. The cataract operation.

*Ballroom, Copley-Plaza Hotel—3:30—Otolaryngology*

A. S. MACMILLAN. An X-ray Study on Lesions of the Œsophagus (statistical study with lantern slides).

HARRIS P. MOSHER. Infection of the Œsophagus in Acute and Chronic Disease; Fibrosis of the Terminal Portion (Cardiospasm), Etiology and Treatment.

EDWARD D. CHURCHILL. The Surgical Approach to the Œsophagus.

*Friday—John Hancock Hall, 2—Otolaryngology*

SAMUEL J. KOPETZKY, New York. Recent developments in the diagnosis of meningitis.

WELLS P. EAGLETON, Newark, N. J. Meningitis—result of disease of the petrous apex and sphenoidal basis.

MARVIN F. JONES, New York. Pathways of approach to the petrous pyramid. Discussion by HARRY P. CAHILL.

WILLIAM MITHOEFER, Cincinnati. When and how shall a nasal sinus inflammation be treated nonsurgically?

EDWARD C. SEWELL, San Francisco. Operative treatment of sinusitis, external approach. Discussion opened by CHARLES T. PORTER.

GABRIEL TUCKER, Philadelphia. Cancer of the larynx.

HENRY B. ORTON, Newark, N. J. Cancer of the laryngopharynx. Discussion opened by LEROY A. SCHALL.

## PRELIMINARY PROGRAM FOR EVENING MEETINGS

*Presidential Meeting—Monday—October 15, 8:15 p.m.*

Address of Welcome: ARTHUR W. ALLEN, M.D., Boston, Chairman, Committee on Arrangements
Introduction of Foreign Guests: FRANKLIN H. MARTIN, M.D., Chicago, Director-General
Address of Retiring President: WILLIAM D. HAGGARD, M.D., Nashville, Tenn.
Inauguration of Officers
Inaugural Address. ROBERT B. GREENOUGH, M.D., Boston
John B. Murphy Oration in Surgery. DONALD C. BALFOUR, M.D., Rochester, Minn.

*Tuesday—October 16, 8:15 p.m.*

Living Grafts of Thyroid and Parathyroid Glands. HARVEY B. STONE, M.D., Baltimore, with the collaboration of JAMES C. OWINGS, M.D., and GEORGE O. GUY, M.D., Baltimore
Endocrine Mechanisms in Certain Functional Gynecological Disorders. EMIL NOVAK, M.D., Baltimore
Subject to be Announced. JOHN FRASER, M.D., Ch.M., F.R.C.S. (Edin.), Edinburgh, Scotland
Fracture Oration. KELLOGG SPEED, M.D., Chicago

*Wednesday—October 17, 8:15 p.m.*

Symposium on Congenital Deformities:
Hydrocephalus and Spina Bifida. WILDER PENFIELD, M.D., Montreal
Congenital Deformities of the Genito-Urinary Tract. HERMON C. BUMPUS, Jr. M.D., Rochester, Minn.
Sterility with Special Reference to Surgical Possibilities. BETHEL SOLOMONS, M.D., F.R.C.P.I., Dublin, Ireland
Diverticulosis and Diverticulitis. IRVIN ABELL, M.D., Louisville

*Thursday—October 18, 8:15 p.m.*

Symposium on Treatment of Infections:
Infections of Clean Operative Wounds. FRANK L. MELENEY, M.D., New York
Infections of the Lip and Face. FREDERICK A. COLLER, M.D., Ann Arbor, Mich.
Phagedenic Ulcer; Its Recognition and Treatment. EMILE HOLMAN, M.D., San Francisco
The Repair of Defects Resulting from Full Thickness Loss of Skin from Burns. JAMES B. BROWN, M.D., St. Louis

*Convocation—Friday—October 19, 8:15 p.m.*

Invocation
Presentation of Candidates for Fellowship. FRANKLIN H. MARTIN, M.D., Chicago, Director-General
Conferring of Fellowships. The President
Conferring of Honorary Fellowships. The President
Presidential Address. ROBERT B. GREENOUGH, M.D., Boston
Fellowship Address

# PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY, GYNECOLOGY, OBSTETRICS, ORTHOPEDICS, UROLOGY, PROCTOLOGY, SURGICAL PATHOLOGY, ETC.

### HARVARD MEDICAL SCHOOL

*Monday*

G. KENNETH COONSE and OTTO AUFRANC—2 (Bldg. C). Demonstration of the mechanical factors controlling the pulmonary circulation.

CHARLES L. SCUDDER and associates—2 (Bldg. E). Symposium on fractures.

*Tuesday*

Building D—2

GEORGE B. WISLOCKI. Studies in mammalian reproduction.

VALY MENKIN. Some problems of inflammation related to surgery.

HENRY G. SCHWARTZ. An experimental study of sympathetic reflexes.

J. L. BREMER. The postnatal growth of the mammalian lung.

HAROLD L. WEATHERFORD. The finer changes in the liver cells in anaphylactic shock.

LESTER S. KING. Some aspects of the hæmato-encephalic barrier.

Building E—2

G. A. BENNETT and WALTER BAUER. Joint changes resulting from trauma.

HUGH K. WARD. Streptococcal infections.

CECIL K. DRINKER. The physiology of the lymphatic system and its bearing on certain problems in surgery

*Wednesday*

Building C—2

HALLOWELL DAVIS. Effect of cerebral anæmia on the electrical response of the cortex.

M. I. GREGERSEN. The use of hypertonic sucrose solution to reduce cerebrospinal fluid pressure without a secondary rise.

WALTER B. CANNON. Some relations of the sympathetic nervous system to surgery.

Building B—2

DAVID CHEEVER. Surgical anatomy of the abdomen, demonstration on cadaver.

Building E—2

FRANK OBER and associates. Orthopedic problems from Children's Hospital. A. H. BREWSTER: Scoliosis. J. KUHNS: Posture and postural scoliosis. P. NORTON: Posterior transplants. H. FITZSIMMONS: Congenita deformities.

*Thursday*

CHARLES L. SCUDDER and associates—2 (Bldg. E). Symposium on fractures.

*Friday*

Symposium on Industrial Surgery—2—Building C

JOHN D. ADAMS and W. A. ROGERS. Injuries of the back.

HENRY MARBLE, F. J. COTTON and J. D. ADAMS. Injuries of the nervous system.

F. J. COTTON and J. H. BURNETT. Colles' fracture.

Orthopedic Clinic—2—Building E

W. GREEN. Osteomyelitis in infants and children.

R. H. MORRIS. Septic hips with involved heads.

A. T. LEGG. Osteomyelitis of the tarsus.

R. JOPLIN. Multiple myeloma.

A. H. BREWSTER. Peroneal spasm.

R. H. MORRIS. Knee flexion.

*Daily*

Warren Museum—M. Canavan, Curator—2

Demonstration of Dwight collection of spines illustrating deformities, anomalies, diseases. Bone tumors, with X-rays, histories, and microscopic slides, with microscopes available for examination (some of these specimens were used in the illustrations in the monograph on "Bone Sarcoma" issued by the American College of Surgeons). Models showing various types of club feet and effects of operation. Pictures illustrating pathological conditions of bone in Dr. Nichols' collection. Fractures and dislocations of bones as they existed before industrial plants provided so many safeguards. Tuberculosis of bones and joints. Syphilis of bones. Dislocation of ends of bones. Collection of old surgical instruments, obstetrical forceps, turnkeys for extracting teeth, urological tools, cupping and leeching instruments.

### FAULKNER HOSPITAL

*Wednesday*

F. J. COTTON, E. G. BRACKETT and associates—9. Bone and joint clinic, operative and dry.

Staff—2. Dry clinic. E. G. BRACKETT: Hip fracture. F. J. COTTON: Bone tumors; fractures of pelvis. H. C. MARBLE: Hand surgery; fractures of the forearm. J. D. ADAMS: Industrial lesions of the knee. WILLIAM A. ROGERS: Compression fracture of spine. E. A. CODMAN: Shoulder lesions. B. GODVIN: Os calcis fractures. W. F. COTTING: Ankle fractures.

*Thursday*

E. L. YOUNG, JR., R. C. COCHRANE, A. R. KIMPTON and associates—9. Operative clinic.

J. R. TORBERT and R. S. TITUS—11. Obstetrical clinic.

S. W. WIGGIN—11. Postoperative pulmonary complications.

Staff—2. Dry clinic. H. L. JOHNSON: Amfetin. E. L. YOUNG, JR.: Immunity in peritoneal cavity. R. C. COCHRANE: Total thyroidectomy. F. G. BALCH, JR.: Injection treatment of hæmorrhoids. H. K. SOWLES: Elbow fractures. Demonstration of X-ray plates and pathological specimens.

### HARVARD UNIVERSITY

(Dillon Field House, Soldier's Field)

*Wednesday*

AUGUSTUS THORNDIKE, JR.—2. Care and prevention of traumatic injuries in athletics; demonstration of protective strapping, padding and apparatus used in modern athletics.

## BOSTON CITY HOSPITAL

### *Monday*

Staff—2. Dry clinic. J. J. REGAN, S. WEISS and D. MUNRO: The eye in arteriosclerosis, hypertension and tumor. G. K. COONSE: Treatment of shock. J. RESNIK and M. RITVO: Pellegrini-Steida's disease, diagnosis and treatment. O. J. HERMANN and E. PARKER, JR.: Synovioma of knee. F. A. SLOWICK: Septic hips.

### *Tuesday*

DAVID D. SCANNELL, SOMERS FRASER, THOMAS W. WICKHAM and JOHN A. SETH—9. General surgical dry clinic.

First Surgical Service—9. General surgical operative clinic. HORACE BINNEY: Thoracoplasty for unilateral phthisis; phrenicectomy for unilateral phthisis. JAMES J. HEPBURN: Repair of ventral hernia; gastric ulcer. GEORGE W. PAPEN: Chronic empyema; cholecystitis.

Fifth Surgical Service—2. Dry clinic. IRVING J. WALKER: Some surgical aspects of jaundice—hyperparathyroidism, end-results; repair of common duct; chondrosarcoma of humerus, end-result; carcinoma of stomach, end-result; ligation of common carotid artery, end-result. FRANCIS F. HENDERSON: Carcinoma of lung; pancreatitis, review of sixty cases. AUGUSTUS RILEY: Prostate and vesicles as foci for retroperitoneal infection; kidney resections; demonstration of cases. CHARLES C. LUND: Peripheral arterial embolism, results of operative treatment on fifteen cases. E. EVERETT O'NEIL: Breast tumors, clinical versus X-ray diagnosis. WILLIAM A. WHITE: Subject to be announced.

ROBERT M. GREEN, JOHN T. WILLIAMS, FREDERICK L. GOOD, JOSEPH P. COHEN and associates—2. Gynecological and obstetrical dry clinic: Treatment of miscarriages; puerperal sepsis; pelvic inflammation.

### *Wednesday*

IRVING J. WALKER, FRANCIS F. HENDERSON, CHARLES C. LUND, E. EVERETT O'NEIL and WILLIAM A. WHITE—9. General surgery, operative clinic.

Bone and joint service—9. Dry clinic. OTTO J. HERMANN: Boston City Hospital bone and joint service. THOMAS H. PETERSON: Colles' fracture therapy; Soutter traction in unreduced fractures of the forearm and old shoulder dislocations. GEORGE K. COONSE: Fracture of the olecranon, new operative repair. OTTO J. HERMANN: Recurrent shoulder dislocations repaired by the Nicola method, end-results, discussion. WILLIAM F. COTTING and MARK H. ROGERS: Subdeltoid bursitis. MARK H. ROGERS: Rupture of supraspinatus tendon, discussion. JOSEPH H. SHORTELL: Spinal fracture, therapy. RUSSELL F. SULLIVAN: Spinal fusions. OTTO J. HERMANN: Compound fracture therapy. FRANK W. MARVIN: Anæsthesia in fractures.

First surgical service—2. Dry clinic. NEWTON C. BROWDER: Results of treatment of Colles' fracture; modern splinting methods in fracture therapy. JAMES J. HEPBURN: Results in treatment of peptic ulcer; giant-cell sarcoma of bone; treatment of ventral hernia. HORACE BINNEY: Methods and results in treatment of acute empyema, lung abscess, bronchiectasis, pulmonary tuberculosis. GEORGE W. PAPEN: Methods and results in treatment of chronic empyema.

Sixth surgical service—2. Dry clinic. JAMES W. SEVER: Separation of femoral epiphysis. MARK H. ROGERS: Ankylosed hips. OTTO J. HERMANN: Treatment of intracapsular fractures of neck of femur, demonstration of cases of recent fractures and ununited fractures. FREDERIC J. COTTON: Pelvic fractures. JOSEPH H. SHORTELL: Bone grafting.

ROBERT M. GREEN, JOHN B. WILLIAMS, FREDERICK L. GOOD, JOSEPH P. COHEN and associates—9. Gynecological and obstetrical operations.

### *Thursday*

OTTO J. HERMANN, JOSEPH H. SHORTELL, WILLIAM F. COTTING, RUSSELL F. SULLIVAN, THOMAS H. PETERSON and G. KENNETH COONSE—9. Operative bone and joint clinic. Ward rounds, demonstration of fracture apparatus, etc.

Second surgical service—9. ROBERT C. COCHRANE: Total thyroidectomy for congestive failure and angina; parathyroid tumors. WILLIAM R. MORRISON: One hundred perforated ulcers of the stomach and duodenum from the Boston City Hospital; stomach surgery, motion picture demonstration; demonstration of following casts—total removal of stomach for cancer with anastomosis of the jejunum to the œsophagus, hour-glass deformity of the stomach, cholecysgastrotomy formed by nature. THOMAS K. RICHARDS: Knee-joint pathology. JOHN J. LUCY: Recurrent intussusception caused by intestinal tumor; carcinoma of the sigmoid. RICHARD I. SMITH: Pancreatitis. HERBERT H. HOWARD: End-results of bilateral renal tuberculosis; importance of postoperative treatment of prostatectomized patient.

Fourth surgical service—2. Dry clinic. ARTHUR R. KIMPTON: Civilian gas gangrene; tetanus; use of amniotic liquid concentrate; cavernous hemangioma of neck; catheter in common bile duct since 1926; ununited fractures. EDWARD HARDING: Demonstration of cases. JOSEPH H. BURNETT: Colles' fracture therapy. H. A. BOUVÉ: Acute traumatic abdomen.

Sixth surgical service—2. Bone and joint dry clinic. WILLIAM F. COTTING: Gonorrheal arthritis of the knee. RUSSELL F. SULLIVAN: Hallux valgus therapy. OTTO J. HERMANN: Fractures of the os calcis therapy, discussion. JOSEPH H. SHORTELL: Bone tumors. FREDERICK W. O'BRIEN: Pre- and postoperative X-ray therapy in malignant tumors of the bone. THOMAS H. PETERSON: "Fender" fractures.

ROBERT M. GREEN, JOHN B. WILLIAMS, FREDERICK L. GOOD, JOSEPH P. COHEN and associates—9. Obstetrical and gynecological operations.

### *Friday*

ARTHUR R. KIMPTON, ROBERT C. COCHRANE, WILLIAM R. MORRISON, STEPHEN P. MALLETT and V. H. KAZANJIAN—9. General surgery, operative clinic.

Staff—9. Gynecological and obstetrical operations.

Staff—2. Dry clinic. J. J. REGAN and W. B. CASTLE: The eye in anæmic patients. STEPHEN P. MALLETT: Fractures of the jaw. WILLIAM R. MORRISON: Visualization of arteries and veins for diagnosis and operation of aneurysm; ligation of the first part of right subclavian artery and subsequent ligation of innominate artery for arteriovenous aneurysm of internal jugular vein and subclavian artery. OTTO J. HERMANN and WILLIAM R. MORRISON: Chronic subluxation of sternal end of clavicle. STEPHEN J. MADDOCK: Discussion of the Baer maggot treatment of chronic osteomyelitis.

Physiotherapy service—9. Dry clinic. JOSEPH RESNIK: Electrodiagnosis. JOSEPH RESNIK, GIRDIE W. DICKINSON, ARTHUR J. COLE, WALDO W. ROBBINS and SIDNEY M. SIMONS: Demonstration of cases and treatment.

## MASSACHUSETTS GENERAL HOSPITAL

*Monday*

Staff—2. Dry clinic. A. W. ALLEN: Bleeding peptic ulcer. JOHN STEWART: Water balance in the surgical patient. C. M. JONES: Nutritional œdema. L. S. MCKITTRICK: Cancer of rectum. E. L. YOUNG, JR.: Cancer of colon. J. V. MEIGS and F. W. HOYT: Rupture of Graafian follicle and corpus luteum. R. H. WALLACE: Treatment of burns.

W. J. MIXTER, JOHN HODGSON and associates—2. Neurosurgical clinic.

V. H. KAZANJIAN, E. M. DALAND and associates—2. Plastic surgery clinic.

T. R. GOETHALS and associates—4. Obstetrical clinic.

*Tuesday*

Staff—9. Operative clinics. General surgical, genito-urinary and thyroid services.

H. C. MARBLE and T. W. HARMER—2. Hand lesions.

GEORGE HOLMES, A. O. HAMPTON and associates—2. Symposium on the roentgen ray.

E. D. CHURCHILL and associates—2. Surgical research laboratories, demonstration of specimens and discussions.

M. N. SMITH-PETERSEN and associates—2. Orthopedic clinic.

Ether Day exercises—4.

*Wednesday*

Staff—9. Operative clinics, general surgical, fracture and circulatory services.

Staff—2. Dry clinic. D. KING: Postoperative pulmonary complications. H. BRADSHAW: Methods in anæsthesia. H. SPRAGUE: Surgery in cardiac patients. L. S. MCKITTRICK and R. H. MILLER: Ulcerative colitis. E. D. CHURCHILL: Cardiolysis. E. B. BENEDICT: Gastroscopy. R. H. MILLER: Osteomyelitis.

J. V. MEIGS, F. ALLBRIGHT and associates—2. Ovarian dysfunction clinic.

P. D. WILSON, A. W. ALLEN, G. A. LELAND and associates—2. Fracture clinic.

*Thursday*

E. A. CODMAN and associates—9. Symposium on lesions of the shoulder.

Staff—9. Operative clinics, general surgical and thoracic services.

T. B. MALLORY—12. Clinical pathological conference.

E. D. CHURCHILL, W. WHITTEMORE and associates—2. Thoracic surgery clinic.

A. W. ALLEN and associates—2. Circulatory diseases clinic.

C. C. SIMMONS and associates—2. Tumor clinic; cancer symposium.

*Friday*

Staff—9. Operative clinics, general surgical and orthopedic services, neurological operations; plastic surgery.

Staff—2. Dry clinic. C. LYONS: Symbiotic infections. B. VINCENT and A. V. BOCK: Surgery of spleen. A. W. ALLEN: Regional ileitis. R. H. MILLER: Tuberculosis of the lymphatic system. R. LINTON: Portal circulation. R. H. SMITHWICK: Significance of negative Graham tests. OLIVER COPE: Subject to be announced. R. ROGERS: Pilonidal sinus.

J. H. MEANS, A. W. ALLEN, E. D. CHURCHILL, R. H. MILLER, E. L. YOUNG, JR. and associates—2. Diseases of the thyroid and parathyroid.

J. D. BARNEY and associates—2. Genito-urinary surgery.

## BOSTON DISPENSARY

*Tuesday*

Tumor clinic staff—9. Dry clinic. FRANK W. MARVIN: Anæsthesia in operative cases. CHARLES M. PROCTOR: Precancerous and benign lesions of the oral cavity. CHARLES E. DUMAS: Radiation technique in malignancy of the throat. LEROY A. SCHALL: Treatment of cancer of tonsil. GEORGE S. SPEARE: Malignant degeneration of sebaceous cysts. LOUIS E. PHANEUF: Precancerous lesions and cancer of the cervix, lantern slide demonstration. ALICE ETTINGER: Early diagnosis of malignancy of gastro-intestinal tract by relief method. HAROLD A. CHAMBERLIN: Papillary tumors of the kidney pelvis. ROGER C. GRAVES: Management of cancer of penis with particular reference to a modified operation for advanced cases. MYRON J. HAHN: Cancer of the prostatic capsule. ISADORE OLEF: Management of malignancy of the lymphatic system. HILBERT F. DAY: Cancer of breast, end-results of dispensary and personal cases. JOEL ROSENBERG: Bleeding carcinoma of breast without tumor. WILLIAM M. SHEDDEN: Management of cancer of rectum with particular reference to irradiation. HAROLD MCMAHON: Relation of pathology department to tumor clinic.

*Wednesday*

Staff—10. Dry clinic. OLIVER G. TINKHAM: Clinical teaching of third year medical students. FRANCIS P. BARNUM: Use of adhesive plaster. P. A. CONSALES: Adenomatous changes in aberrant thyroid. HILBERT F. DAY: Management of a varicose vein clinic, where over 150 treatments a week are given. EDWARD T. WHITNEY: Varicose ulcers, demonstration of cases and treatment. WALTER S. LEVENSON: High ligation of varicose veins. WILLIAM M. SANTORO: Injection treatment of varicoceles. S. SEYMOUR HORLICK: Results of multiple injections of varicose veins at same visit. HILBERT F. DAY: Results of excision of sloughs following injection treatment.

*Thursday*

Staff—9. Dry clinic. JOHN D. ADAMS: Shueller-Christian disease (xanthomatosis); bone tumors. ROY E. MABREY: Chordoma and chondrosarcoma. WILLIAM A. HINTON: Detection of syphilis as an aid in practice of surgery. FRANCIS M. THURMON: Syphilis and the differential diagnosis of surgical conditions. JOSEPH SKIRBALL: Ophthalmic studies in syphilis. GRACE E. ROCHFORD: An unusual gynecological condition. LOUIS A. O. GODDU: Pain in the shoulder girdle. ROBERT W. BUCK: Kidney function; renal function tests. WILLIAM E. DAVIS: Some observations in treatment of peptic ulcer in out-patient clinic. ALICE ETTINGER: Diagnosis of activity of duodenal ulcer by X-ray. KATHERINE S. ANDREWS: Hiatus hernias. HILBERT F. DAY: Solitary gallstone pain relieved by posture. Demonstration of interesting X-ray plates of peptic ulcer and gall-bladder disease.

## LAKEVILLE SANATORIUM

*Wednesday*

Z. B. ADAMS—9:30. Ankylosis of hip, operative. Ward rounds.

Staff—2. Dry clinic: Tuberculosis of lymph nodes, genito-urinary tract, eye, gastro-intestinal tract, peritoneum, and skin.

Z. B. ADAMS—2. Orthopedic dry clinic.

## CHILDREN'S HOSPITAL

*Monday*

F. R. OBER, W. E. LADD and associates—2. Fractures in children.

*Tuesday*

F. R. OBER and associates—9. Orthopedic operations.

W. E. LADD—9:30. Plastic repair of harelip and cleft palate, demonstration of cases, motion picture demonstration.

THOMAS H. LANMAN—10. Acute osteomyelitis in infancy and childhood.

PATRICK J. MAHONEY—10:30. The use of various types of skin grafts in children's surgery.

HENRY HUDSON, JR.—11. Acute appendicitis in childhood; Meckel's diverticulum.

Staff—2. Operative clinic, surgery in infants and children.

Staff—2. Orthopedic clinic. A. T. LEGG: Early treatment and the prevention of deformities in poliomyelitis. F. R. OBER: Shoulder operations. J. W. SEVER: Stabilization of the ankle joint. M. KATZEFF: Tendon transplants. A. T. LEGG: Abductor limp.

*Wednesday*

F. R. OBER and associates—9. Orthopedic clinic at Peabody Home.

Staff—9:30. Operative clinic.

W. E. LADD—2. Congenital hypertrophic pyloric stenosis; intussusception, diagnosis and treatment.

DONALD W. MACCOLLUM—2:30. Treatment of undescended testes, end-results over a 34 year period.

THOMAS H. LANMAN—3. Chronic pulmonary suppuration, demonstration of cases.

HENRY HUDSON, JR.—3:15. Empyema in childhood, its treatment.

SIDNEY FARBER—3:30. Surgical pathology of malignant tumors in infancy and childhood, followed by demonstration of pathological specimens in department of pathology.

EDWARD C. VOGT—3:45. Roentgenological studies of unusual bone tumors in infancy and childhood.

*Thursday*

F. R. OBER and associates—9. Orthopedic operations.

W. E. LADD—9:30. Intestinal atresia, diagnosis and treatment, demonstration of cases, lantern slide demonstration.

PATRICK J. MAHONEY—10. Types of tracheo-œsophageal fistulæ; differential diagnosis and operative treatment; congenital and acquired œsophageal stricture, demonstration of methods of dilatation.

W. E. LADD—10:30. Atresia of the bile ducts, diagnosis and treatment; choleductus cyst, diagnosis and treatment.

THOMAS H. LANMAN—11. Ureteral transplantation for exstrophy of the bladder, demonstration of treated cases.

Staff—2. Operative clinic, surgery in infants and children.

Staff—2. Orthopedic dry clinic. A. H. BREWSTER: Claw feet. F. H. MORRIS: Torticollis, mastoid approach. H. FITZSIMMONS: Discussion. F. R. OBER: Semilunar cartilage. H. FITZSIMMONS: Osteoclasis. R. H. MORRIS: Club feet.

*Friday*

Staff—9. Orthopedic clinic. S. M. FITCHET: Cleidocranial dysostosis. F. R. OBER: Shelf operations; Sprengel's deformity. S. M. FITCHET: Flexion deformity of the hips. A. T. LEGG: Coxa plana. J. W. SEVER: Obstetrical paralysis.

Staff—9:30. Operative clinic, surgery in infants and children.

W. E. LADD—2. Acute and chronic lymphadenitis, demonstration of cases, lantern slide demonstration.

PATRICK J. MAHONEY—2:30. Treatment of fresh burns.

DONALD W. MACCOLLUM—2:45. Treatment of hemangioma by endothermy, demonstration of cases.

W. E. LADD—3. Surgical significance of pyuria in infancy and childhood, demonstration of cases, lantern slide demonstration.

T. H. LANMAN—3:30. Malignant bladder tumors in childhood.

## PETER BENT BRIGHAM HOSPITAL

*Monday*

DAVID CHEEVER—2. Surgical clinic.

H. F. NEWTON—3. Thoracoplasty.

S. A. LEVINE—3:30. Circulatory emergencies in surgical patients.

*Tuesday*

Staff—9. General surgery, operative clinic.

E. C. CUTLER—2. Total thyroidectomy.

C. L. DERICK—3. Symptoms and diagnosis of vascular thrombosis.

JOHN HOMANS—3:30. Swollen legs.

*Wednesday*

Staff—9. General surgery, operative clinic.

HENRY A. CHRISTIAN—2. Medical clinic.

M. C. SOSMAN—3. Recent developments in diagnostic radiology.

E. S. EMERY, JR.—3:30. Results of surgical procedures for relief of peptic ulcer.

*Thursday*

Staff—9. General surgery, operative clinic.

W. C. QUINBY—2. Indications for and results of tota cystectomy.

J. C. ECKELS and G. P. GRABFIELD—2:30. Denervated kidney, studied by means of the divided bladder.

M. S. STROCK—3. Methods of fixation of fractures of the jaw.

S. B. WOLBACH—3:30. Demonstration of surgical pathology.

*Friday*

Staff—9. General surgery, operative clinic.

DAVID CHEEVER—2. Cancer of the stomach.

F. C. NEWTON—2:30. Cancer of the rectum.

R. FITZ—3. Function of the spleen.

W. P. MURPHY—3:30. Treatment of pernicious anæmia, motion picture demonstration.

F. R. OBER—3:45. Treatment of neuromuscular sequelæ of pernicious anæmia.

## MALDEN HOSPITAL

*Wednesday*

L. E. PHANEUF and N. A. GALLAGHER—9. Gynecologica operations.

R. SULLIVAN—9. Orthopedic clinic.

L. W. MCQUIRE—9. Amebic dysentery and its complications.

C. F. LYNCH, D. J. DUGGAN, I. J. WALKER and F. W. GAY—2. Surgical operations.

Staff—2. Dry clinic. J. S. ROONEY: Pathological demonstration. I. J. WALKER: Discussion of jaundice with demonstration of liver specimens. L. SILVA: Discussion of coronary and gall-bladder disease in middle-aged people with electrocardiographic tracings. C. H. STAPLES: Hyperpituitarism, demonstration of cases.

## NEW ENGLAND DEACONESS HOSPITAL

*Tuesday*

F. H. LAHEY, H. M. CLUTE, R. B. CATTELL and R. H. OVERHOLT—9. General surgical operations.

GILBERT HORRAX and JAMES POPPEN—9. Neurosurgical operations.

RICHARD H. OVERHOLT—9. Thoracic surgery operations.

G. E. HAGGART—9. Orthopedic operations.

JAMES B. HICKS—9. Urological operations.

LINCOLN F. SISE, PHILIP D. WOODBRIDGE and URBAN EVERSOLE—9. Anæsthesia.

F. H. LAHEY—9. Œsophageal diverticulum, dry clinic.

GILBERT HORRAX—9. Malignant exophthalmos, dry clinic.

Staff—2. Dry clinics. H. M. CLUTE: Management of obstructive jaundice; exploration of common duct. GILBERT HORRAX: Brain tumors; malignant exophthalmos. SARA M. JORDAN: Gastric cancer and ulcer; gastrojejunal ulcer. F. H. LAHEY: Total gastrectomy for cancer; gastrojejunal colic fistula; surgery of intractable ulcer. EVERETT KIEFER: Hæmorrhage in peptic ulcer. RICHARD B. CATTELL: Embolectomy; parathyroid tetany.

*Wednesday*

F. H. LAHEY, H. M. CLUTE, R. B. CATTELL and R. H. OVERHOLT—9. General surgical operations.

GILBERT HORRAX and JAMES POPPEN—9. Neurosurgical operations.

RICHARD H. OVERHOLT—9. Thoracic surgery operations.

G. E. HAGGART—9. Orthopedic operations.

JAMES B. HICKS—9. Urological operations.

LINCOLN F. SISE, PHILIP D. WOODBRIDGE and URBAN EVERSOLE—9. Anæsthesia.

Staff—2. Dry clinics: G. E. HAGGART: Subdeltoid bursitis; treatment of flexion deformities. JAMES L. POPPEN: End-results in trigeminal neuralgia; spinal fluid pressure dynamics. FRANK H. LAHEY: Œsophageal diverticulum; hyperthyroidism. H. M. CLUTE: End-results in hyperthyroidism. LEWIS M. HURXTHAL: Thyrocardiac patients. EVERETT KIEFER: Ulcerative colitis. RICHARD B. CATTELL: Surgical treatment of ulcerative colitis. RICHARD OVERHOLT: Limited thoracoplasty in pulmonary tuberculosis; cancer of lung.

*Thursday*

E. P. JOSLIN, H. F. ROOT, L. S. MCKITTRICK and T. C. PRATT—9. Surgical and medical diabetic ward rounds.

T. C. PRATT—10:30. Thigh amputation for diabetic gangrene.

L. S. MCKITTRICK—10:30. Gritti-Stokes amputation for diabetic gangrene.

Staff—2. Dry clinic: Surgery in diabetes mellitus. E. P. JOSLIN: Medical care of the surgical patient. L. RICHARDS: Otolaryngological aspect of diabetes. J. H. WAITE: Cataract surgery in diabetes mellitus. Gangrene and infection of the lower extremities: H. F. ROOT, preventive measures; L. S. MCKITTRICK, factors influencing the level of amputation; T. C. PRATT, indications for guillotine amputation. R. S. TITIS: Obstetrics in diabetes. MARK ROGERS: Depressed fracture of the spine in diabetes; subdeltoid bursitis in diabetes mellitus.

*Friday*

F. H. LAHEY, H. M. CLUTE, R. B. CATTELL and R. H. OVERHOLT—9. General surgical operations.

GILBERT HORRAX and JAMES POPPEN—9. Neurosurgical operations.

RICHARD H. OVERHOLT—9. Thoracic surgery operations.

G. E. HAGGART—9. Orthopedic operations.

JAMES B. HICKS—9. Urological operations.

LINCOLN F. SISE, PHILIP D. WOODBRIDGE and URBAN EVERSOLE—9. Anæsthesia.

Staff—2. Dry clinics. R. B. CATTELL: Cancer of the colon and rectum. GILBERT HORRAX: Root resection for trigeminal neuralgia; cordotomy for pain. JAMES POPPEN: Spinal cord tumors. RICHARD OVERHOLT: Cancer of the breast. JAMES B. HICKS: Transurethral resection of the prostate. H. M. CLUTE: Subphrenic abscess. F. H. LAHEY and FRANK N. ALLAN: Parathyroid tumors.

## CAMBRIDGE CITY HOSPITAL

*Tuesday*

H. H. GERMAIN, D. F. MAHONEY, E. J. O'BRIEN, J. J. MURPHY and E. D'ERRICO—9. General surgical clinic, operative and dry. H. H. GERMAIN: Results in surgery of the shoulder, nerve suture and skin graft following burn; arthroplasty of lower jaw. D. F. MAHONEY: Fracture of pelvis and humerus. E. J. O'BRIEN: Results of transurethral resection of prostate; massive diverticulum in child 2½ years old; results in cases of spina bifida. F. W. O'BRIEN: Traumatic spine and head injuries, demonstration of X-ray films. B. A. GODVIN and WALDO ROBBINS: Orthopedic and fracture clinic.

E. D'ERRICO—2. Injection treatment for varicose veins and ulcers, presentation of cases and motion pictures.

E. DOWNEY—2. Injection treatment of hæmorrhoids, demonstration of cases.

*Wednesday*

H. H. GERMAIN—9. General surgical operations.

Staff—9. Dry clinic. MAXWELL MACDONALD: Encephalography as an aid to diagnosis in cerebral lesions. F. G. MINITER and T. E. DINAN: Results of accessory sinus operations, demonstration of cases. R. D. YOUNG: Cæsarean section. F. J. LYNCH: Subject to be announced later. J. J. MURPHY: Treatment problems of burns in a general hospital. J. W. ROCKETT: Oral surgery operations. ARTHUR SARGENT and WILLIAM LANNIGAN: Orthopedic and fracture clinic. F. O. O'BRIEN: Traumatic spine and head injuries, demonstration of X-ray films. J. W. ROCKETT and F. MCLEAN: Fractures of lower and upper jaw. M. SHEA: Arthroplasty of lower jaw.

E. J. O'BRIEN and L. ROCKWELL—10:30. General surgical operations.

E. D'ERRICO—2. Acute torsion of great omentum; appendicitis complicating pregnancy.

*Thursday*

D. F. MAHONEY—9. General surgical operations.

J. J. MURPHY—10:30. General surgical operations. Problem of rupture of urethra, fracture of pelvis, fracture of femur.

F. O. O'BRIEN—11. Traumatic spine and head injuries, demonstration of X-ray films.

## WALTHAM HOSPITAL

*Friday*

R. L. DENORMANDIE, T. W. HARMER, D. MUNRO, J. D. BARNEY, J. W. SEVER, H. Q. GALLUPE, R. COLLINS and H. A. WOOD—9. Surgical operations.

R. L. DENORMANDIE, T. W. HARMER, D. MUNRO, J. D. BARNEY, J. W. SEVER, H. Q. GALLUPE, R. COLLINS and H. A. WOOD—2. Dry clinics: General surgery, orthopedics, obstetrics, pathology, etc.

## BETH ISRAEL HOSPITAL

### *Monday*

Staff—2:30. Dry clinic. J. SEARS: Prophylactic vein ligation against embolism from phlebitis of the internal saphenous vein. M. BLOOMBERG: The prevention of scar tissue by use of baudruche, experimental and clinical experiences, demonstration of cases. W. LEVENSON: Intraperitoneal adhesions. L. HERMANSON: Transfusions during active bleeding from peptic ulcer. A. THURMAN: Surgical treatment of cholecystitis. J. MEZER: Subacute pancreatitis. J. FINE: Postoperative distension, an experimental study.

### *Tuesday*

Staff—9. Symposium on total thyroidectomy for chronic heart diseases and angina pectoris. H. BLUMGART: Rationale of total thyroidectomy in chronic heart disease. J. RISEMAN: End-results of total thyroidectomy in angina pectoris. D. DAVID: End-results of total thyroidectomy in congestive heart failure. H. BLUMGART: Indications and contra-indications for surgery, selection of cases. C. G. MIXTER: General surgical considerations in total thyroidectomy. D. BERLIN: Technical considerations in total thyroidectomy. DOROTHY GILLIGAN: Postoperative parathyroid tetany. D. DAVIS: Treatment of postoperative complications. J. FINE: A technique for relief of temporary bilateral recurrent nerve injury. A. WEINSTEIN and M. ALTSCHULE: Total thyroidectomy, motion picture demonstration; demonstration of cases.

C. G. MIXTER and associates—2. Surgical operations including total thyroidectomy.

### *Wednesday*

C. G. MIXTER and associates—9. Surgical operations.

Staff—10:30. Dry clinic. W. DAMESHEK: Blood changes in surgical conditions. DR. MORRISON: Medical conditions simulating surgical disease. DR. DEROW: Significance of postoperative rise in nonprotein nitrogen. ARNOLD STARR and DR. MUELLNER: Postoperative renal suppression. C. G. MIXTER: Surgery of the large intestine. S. CARGILL and DR. FALCON-LESSES: Thyroid clinic experiences, demonstration of cases.

E. G. CRABTREE and associates—9. Dry clinic, genitourinary surgery. Symposium on the female bladder: Demonstration of various factors related to function in health, pregnancy and disease; use of urethrogram and cystogram in diagnosis of bladder displacements and deformities in the multiparous woman, results of routine surgery; treatment of infections in the abnormal bladder.

Staff—2. Dry clinic. C. BEARSE: Acute appendicitis beyond age of fifty. W. J. MIXTER: Subject to be announced. B. RAPAPORT: Comparison on postoperative complications following spinal and general anæsthesia. J. FINE: Relation of diaphragm to the efficiency of cough. L. NASON: Gas bacillus infection complicating laparotomy. B. BANKS: Differential diagnosis of jaundice. DR. JANKELSON: Indications for ileostomy in ulcerative colitis. C. G. MIXTER: Regional ileitis. M. BARRON: Is radical resection for carcinoma of rectum the best procedure?

### *Thursday*

Staff—9. Symposium on total thyroidectomy for chronic heart disease and angina pectoris. H. BLUMGART: Rationale of total thyroidectomy in chronic heart disease. J. RISEMAN: End-results of total thyroidectomy in angina pectoris. D. DAVIS: End-results of total thyroidectomy in congestive heart failure. H. BLUMGART: Indications and contra-indications for surgery, selection of cases. C. G. MIXTER: General surgical considerations in total thyroidectomy. D. BERLIN: Technical considerations in total thyroidectomy. DOROTHY GILLIGAN: Postoperative parathyroid tetany. D. DAVIS: Treatment of postoperative complications. J. FINE: Technique for relief of temporary bilateral recurrent nerve injury. A. WEINSTEIN and M. ALTSCHULE: Total thyroidectomy, motion picture demonstration; demonstration of cases.

C. G. MIXTER and associates—2. Surgical operations including total thyroidectomy.

E. G. CRABTREE and associates—2. Bladder surgery, operative and dry clinic.

### *Friday*

C. G. MIXTER and associates—9. General surgical operations.

W. J. MIXTER—9. Craniotomy.

MARK H. ROGERS and associates—9. Orthopedic dry clinic: Manipulation of subdeltoid bursitis, methods and results; slipping epiphysis, femoral neck; club foot, demonstration of application of plaster cast; method of drainage of septic knees, posterior incision; stenosing tenovaginitis, operative results; Nicola operation, end-results in cases of recurrent dislocation of shoulder; marble bones, repeated fractures of femur; fractures of long bones in Paget's disease; compression fractures of spine in diabetes and old age; correction of hallux valgus, temporary paralysis of sensory nerve affecting the joint.

E. G. CRABTREE and associates—2. Renal surgery.

Staff—2. Symposium on tumors. WILLIAM DAMESHEK: Malignancy of blood forming organs. L. M. FREEDMAN and H. F. FREIDMAN: Laryngeal carcinoma, diagnosis and treatment; presentation of cases. R. DAVIDOFF, C. G. MIXTER and H. F. FREIDMAN: Breast tumors, differential diagnosis, surgical and radiation treatment. DR. SCHLESINGER: Diagnosis of malignancy from ascitic and pleural fluids. H. F. FREIDMAN and R. DAVIDOFF: Policy toward married women in regard to carcinoma of the uterine cervix. S. A. ROBBINS, E. G. CRABTREE and G. E. PRATHER: Renal tumors, roentgen diagnosis, surgical treatment, results. G. E. PRATHER: Testicular tumors. J. H. SCHWARTZ and H. F. FREIDMAN: Carcinoma of the skin, diagnosis, motion picture demonstration of radium treatment.

### *Daily Exhibit in Medical Research Laboratories*

Blood changes in surgical conditions; total thyroidectomy for chronic heart disease; renal function tests in surgery; demonstration of interesting and unusual X-ray films; surgical pathological specimens with case histories, photographs, etc.

## LONG ISLAND HOSPITAL

### *Wednesday*

R. H. MORRIS and T. H. PETERSON—9. Fracture demonstration.

H. R. VIETS—9. Neurosurgical diagnosis.

J. H. CUNNINGHAM and C. S. SWAN—9. Urological operations.

A. S. MACMILLAN—2. X-ray demonstration.

I. B. AKERSON—2. Pathological demonstration.

C. L. SWAN, R. I. SMITH and T. C. PRATT—2. General surgical operations.

## ST. ELIZABETH'S HOSPITAL

*Tuesday*

JOSEPH STANTON—9. Subtotal thyroidectomy.
GEORGE KEENAN—9. Hysterectomy.
CHARLES KICKHAM—9. Supravaginal hysterectomy.
E. J. O'BRIEN—9. Transurethral resection of prostate gland.
E. M. HODGKINS—10. Repair of postincisional hernia with peritoneal fascial strips, by utilizing sac.
JOHN SPELLMAN—10. Radical operation for cancer of tongue.
THOMAS BRODERICK—10. Spine fusion.
BENEDICT BOLAND—11. Low transverse cervical section.
LAURENCE LOUIS—11. Total thyroidectomy.
Staff—2. Dry clinic. CHARLES KICKHAM: Series of spontaneous rupture of the uterus. RUSSELL SULLIVAN: End-results of bone and joint problems. LAURENCE LOUIS: Postoperative total thyroidectomy for (a) angina pectoris, (b) congestive heart disease. FRANCIS P. MCCARTHY: Frozen sections; demonstration and discussion of pathological specimens.

*Wednesday*

JOSEPH STANTON—9. Hysterectomy.
GEORGE KEENAN—9. Cholecystectomy.
RUSSELL SULLIVAN—9. Nikola operation for recurrence of dislocation of shoulder.
LAURENCE LOUIS—9. Radical operation, cancer of breast.
E. J. O'BRIEN—10. Nephrectomy for tuberculous kidney.
WILLIAM MCDONALD—10. Operation for correction of childbirth injury.
THOMAS BRODERICK—10. Reconstruction of hip joint.
M. MCGARTY—10. Removal of cartilage from knee joint.
EDWARD HODGKINS—11. Repair of recurrent inguinal hernia with fascial strips.
MARTIN SPELLMAN—11. Sacro-iliac arthrodesis.
Staff—2. Dry clinic. WILLIAM DOLAN: Industrial surgery. JOHN WHORISKEY: Diseases of the gall bladder, medical cases either refusing operation or being surgically unfit, demonstration of cases. FRANK JANTZEN: Cholecystitis and liver dysfunction (a) with hypopituitary syndrome, (b) with hypothyroid syndrome. MICHAEL MCGARTY: Flap graft in reconstruction of foot. JOHN CASEY: Disease of spleen from a surgical standpoint. THOMAS BRODERICK: Demonstration of spinal cases with operative technique, lantern slides.

*Thursday*

JOSEPH STANTON—9. Gastro-enterostomy.
BRYANT WETHERELL—9. Nephrectomy.
FRANK JANTZEN—9. Inguinal herniotomy under local anæsthesia.
EDWARD HODGKINS—9. Gastro-enterostomy.
THOMAS BRODERICK—10. Reconstruction of hip joint.
CHARLES KICKHAM—10. Prolapsed uterus with perineal repair and suspension.
WILLIAM DONOVAN—10. Suprapubic prostatectomy.
EDWARD O'BRIEN—10. Suprapubic cystostomy.
MICHAEL MCGARTY—11. Fascial repair of double recurrent inguinal hernia.
BENEDICT BOLAND—11. Tubal plastic for sterility.
Staff—2. Dry clinic. WILLIAM O'HALLORAN: Medicine from a pre-operative and postoperative standpoint. BRYANT WETHERELL: Discussion of diagnosis of carcinoma of bladder. WILLIAM MCDONALD: Polyneuritis in pregnancy. JAMES LYNCH: Vulval phlebitis complicating pregnancy, antenatal. JOSEPH STANTON: Hypocalcemia of unusual origin, gastric ulcer; demonstration of interesting clinical cases.

## NEWTON HOSPITAL

*Tuesday*

E. D. LEONARD—9. Breast amputation.
G. M. MORRISON—9. Reconstruction of elbow.
G. K. COONSE—9. Operation for fractured patellæ.
E. G. CRABTREE—9. Cystotomy.
F. W. MARVIN—9. Pantocain anæsthesia.
D. G. NUTTER—9:15. Desmoid cysts of the abdomen.
R. I. SMITH—9:30. Carcinoma of the duodenum.
G. C. PRATHER—9:30. Renal calculus.
N. P. BRACKETT—10. Strangulated hernia in the aged.
D. G. NUTTER—10. Hysterectomy for fibroids.
G. K. COONSE—10. Triceps repair of olecranon fracture.
G. M. MORRISON—10. Ankle fractures.
F. R. CLARK—10. Cæsarean section.
H. WATTERS—10:15. Intussusception in infancy.
D. G. WILCOX—10:30. Pyosalpinx.
E. D. LEONARD—10:45. Paralytic ileus.
R. I. SMITH—11. Complete thyroidectomy for angina pectoris.
N. P. BRACKETT—11. Cholecystectomy.
H. G. DUNPHY—11. Ligation of saphenous vein for varicose ulcer.
Fracture and Orthopedic services—9. Dry clinic: Demonstration of application of plaster casts, Boehler technique; application of Anderson well leg traction apparatus; treatment of fractures of the spine, including hyperextension, frames, jackets, etc.; treatment of Colles fracture by Cotton-Loder method demonstration of new type humeral traction abduction splint.
Staff—2. Symposium on obstetrics: E. GRANVILLE CRABTREE: Discussion of urinary tract infection in pregnancy. GEORGE C. PRATHER: Discussion of lone kidneys in pregnancy. F. R. CLARK, M. F. EADES and G. E. MAY: Pre- and postoperative care of patients.
ROBERT G. VANCE—2. X-rays of traumatic skulls.

## COLLIS P. HUNTINGTON MEMORIAL HOSPITAL

*Monday*

Staff—2:15. Tumors and diseases of bones, dry clinic. J. C. AUB: Calcium metabolism in diseases of the bones. CHANNING C. SIMMONS: Malignant tumors of bone. RICHARD DRESSER: Radiological diagnosis of bone tumors and certain rare forms of skeletal diseases. C. C. FRANSEEN: The phosphatase determination in bone tumors and skeletal diseases.
GEORGE A. LELAND and J. V. MEIGS—2:15. Carcinoma of the cervix.

*Wednesday*

Staff—2:15. Carcinoma of the oral mucous membrane, dry clinic. CHANNING C. SIMMONS: Choice of treatment in the individual case. C. C. LUND: Results of treatment of cancer of lip. GRANTLEY W. TAYLOR: Carcinoma of the mouth in the female. RICHARD DRESSER: Radiation treatment of oral cancer. CHARLES B. HOPKINS: Prophylaxis of cancer of the mouth. SOMERS STURGIS: Electrical currents between fillings of different metals as an etiological factor in leucoplakia and cancer of the mouth.
CHANNING C. SIMMONS, GRANTLEY W. TAYLOR and RICHARD DRESSER—2:15. Cancer of the breast.

## MASSACHUSETTS MEMORIAL HOSPITAL

*Daily*

Staff—9. Operative clinics.
Staff—2. Dry clinics.

## PALMER MEMORIAL HOSPITAL

*Tuesday*

Staff—9. Treatment of malignant disease, including surgery, electrosurgery and radium implantation, operative clinic.

Staff—2. Dry clinics. G. A. LELAND: Carcinoma of cervix. FLETCHER COLBY: Urinary tract complications from carcinoma of the cervix. L. S. MCKITTRICK: Interstitial radiation for carcinoma of the breast. R. H. DRESSER: Irradiation of the ovary in cancer of the breast. GEORGE G. SMITH: Diversion of the urinary stream. JOHN HODGSON: Relief of pain in malignant disease.

*Wednesday*

Staff—9. Treatment of malignant disease including surgery, electrosurgery and radium implantation, operative clinic.

*Thursday*

Staff—2. Dry clinics. D. F. JONES: Surgical management of carcinoma of the rectum. L. S. MCKITTRICK: Factors favoring early diagnosis of cancer of the colon, principles of treatment. R. H. SWEET: Polyposis of the colon. SHIELDS WARREN: Pathological aspects of rectal polypi. WYMAN RICHARDSON: Blood dyscrasias after gastrectomy and short-circuiting operations on the intestinal tract.

*Friday*

Staff—9. Treatment of malignant disease including surgery, electrosurgery and radium implantation, operative clinic.

## NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

*Tuesday*

Staff—9. Surgical operations.

Staff—2. Dry clinic: Carcinoma of fundus in young woman treated for amenorrhea with antuitrin-S; fibrosarcoma of liver in six year old child; carcinoma of kidney with metastasis in three year old child; unusual pathological specimens with case histories.

*Wednesday*

Staff—9. Surgical operations.

Staff—9. Obstetrical analgesia demonstration of cases; ward rounds; prenatal clinic; parent-teaching clinic.

*Thursday*

Staff—9. Surgical operations.

Staff—9. Orthopedic operations; demonstration of unusual case of fractured pelvis.

MIRIAM KATZEFF—9. Familial muscular dystrophy.

*Friday*

Staff—9. Surgical operations.

## STATE PRISON COLONY

*Day to be announced*

HILBERT DAY. Practice of medicine in a modern correctional institution.

WILFRED BLOOMBERG. Psychiatric approach to prison medicine.

HENRY R. CRAIG. Unusual incidence of peptic ulcer in a prison population.

GEORGE H. LYONS. Minor surgical injuries in a protected population.

GEORGE ROTHBLATT. Dental conditions causing personality changes.

## FREE HOSPITAL FOR WOMEN

*Tuesday*

F. A. PEMBERTON, G. V. SMITH and S. C. GRAVES—9. Operative and dry clinic: Carcinoma of cervix uteri, treatment and results, prevention, diagnosis of early cases, relation to cervicitis and its treatment, complications of radium treatment, relief of pain; carcinoma of fundus uteri, treatment and results, classification; other tumors of uterus—fibroids, adenomyoma.

*Wednesday*

F. A. PEMBERTON, G. V. SMITH and PAUL YOUNGE—9. Operative and dry clinic: Tumors of the ovary, diagnosis, treatment and results. Cyst adenoma, granulosa cell tumor, Brenner tumor, teratoma; endometriosis, diagnosis and treatment; tumors of tubes, round ligaments and vagina.

*Thursday*

G. V. SMITH and JOHN ROCK—9. Operative and dry clinic: Sterility, diagnosis, treatment and results; menorrhagia and metrorrhagia, diagnosis, treatment and results; endocrine research; dysmenorrhea.

*Friday*

F. A. PEMBERTON, E. B. SHEEHAN and S. C. GRAVES—9. Operative and dry clinic: Prolapse, procidentia; complete tear of perineum; vesico- and rectovaginal fistulæ; kraurosis vulvæ, carcinoma vulvæ; trichomonas vaginale; tumors of breast, value of X-ray treatment.

## NEW ENGLAND BAPTIST HOSPITAL

*Tuesday*

HALSEY B. LODER—9. Operative clinic.

Staff—9. Dry clinics. HALSEY B. LODER: Portal thrombosis; ulcerative colitis; gall stones, pancreatitis; uterine fibroids. A. A. HORNOR: Ulcerative colitis. ROBERT L. DENORMANDIE and DELOS J. BRISTOL: Blood transfusion in obstetrics; management of borderline obstetrical cases; anæsthesia and analgesia in obstetrics; prevention of eclampsia.

*Thursday*

F. H. LAHEY, H. M. CLUTE, R. B. CATTELL and R. H. OVERHOLT—9. General surgery, operative clinic.

GILBERT HORRAX and JAMES POPPEN—9. Neurosurgical operations.

G. E. HAGGART—9. Orthopedic surgery.

JAMES B. HICKS—9. Urological surgery.

LINCOLN F. SISE, PHILIP D. WOODBRIDGE and URBAN EVERSOLE—9. Anæsthesia.

## BOSTON LYING-IN HOSPITAL

*Tuesday and Thursday*

FREDERICK C. IRVING and associates—9. Obstetrical operations; demonstrations of premature nursery, X-ray department, research laboratories and hospital wards.

FREDERICK C. IRVING and associates—2. Dry clinic: Fetal roentgenometry; anæmia in pregnancy; treatment of heart disease in pregnancy; treatment of diabetes in pregnancy; management of neglected cases of cephalopelvic disproportion; treatment of placenta prævia; separation of the symphysis pubis; kidney function tests in pregnancy; classification of the albuminuric and hypertensive conditions in pregnancy; factors which make for viability in premature infants; erythroblastosis fetalis; barbiturates and other analgesic drugs in labor.

## ROBERT B. BRIGHAM HOSPITAL

*Monday*

L. M. SPEAR—2. Classification of types of arthritis.
L. T. SWAIM and J. KUHNS—3. Treatment and orthopedic principles involved in arthritis.

*Tuesday*

H. K. THOMPSON—2. Clinical analysis of arthritis with reference to classification and treatment.
P. D. WILSON and S. ROBERTS—3. Discussion of operative procedures, demonstration of end-results.

*Wednesday*

L. M. SPEAR—2. Classification of types of arthritis.
L. T. SWAIM and J. KUHNS—3. Treatment and orthopedic principles involved in arthritis.

*Thursday*

H. K. THOMPSON—2. Clinical analysis of arthritis with reference to classification and treatment.
P. D. WILSON and S. ROBERTS—3. Discussion of operative procedures, demonstration of end-results.

## EVANGELINE BOOTH MATERNITY HOSPITAL

*Wednesday*

A. K. PAINE, H. S. FINKEL, W. J. MCDONALD, M. G. BERLIN, J. HOPKINS, D. GOLDFARB, A. A. LEVI, J. J. CONWAY, H. BAKER, S. OSGOOD and R. T. PHILLIPS—9. Gynecological operations and obstetrical procedures.

Staff—2. A review by demonstration, charts, pictures and exhibits, of the obstetrical experience of the Booth Hospital: Maternal mortality, factors responsible for the declining rate at the Booth Hospital; the bleeding cases, statistics, management and results; obstetrical sepsis; amnesia, analgesia and anæsthesia in labor, results from the standpoint of safety, efficiency, effects on operative incidence; Cæsarean section, incidence, indications and mortality; toxemia of pregnancy, treatment methods and results over a fourteen year period; "debunking" pelvimetry; heart disease complicated by pregnancy; fetal mortality, analysis of four hundred cases, pathology.

## INDUSTRIAL SURGERY

*Tuesday*

H. C. MARBLE and H. P. TOWLE (142 Berkeley Street)—9.
D. LYNCH and B. GODVIN (245 State Street)—9.

*Wednesday*

G. W. MORSE (31 St. James Avenue)—9.

*Thursday*

WILLIAM DOLAN (110 Milk Street)—9.

*Friday*

J. H. SHORTELL (260 Tremont Street)—9.
D. LYNCH and B. GODVIN (245 State Street)—9.

## CARNEY HOSPITAL

*Daily*

F. B. LUND and associates—9. General surgical operations.
L. E. PHANEUF and associates—9. Gynecological and obstetrical operations.
W. R. MACAUSLAND and associates—9. Orthopedic operations.
R. S. GRAVES and associates—9. Urological operations.
Staff—2:15. Dry clinics.

## PONDVILLE STATE CANCER HOSPITAL

*Tuesday—2 p.m.*

ERNEST M. DALAND. The Massachusetts cancer program.
HENRY JACKSON, JR. Some aspects of malignant lymphoma.
JOE V. MEIGS. Ovarian tumors.
LANGDON PARSONS. Treatment of cancer of the cervix by X-ray followed by radium.
ROGER GRAVES. Cancer of the prostate with metastases.
CHARLES KICKHAM. Cancer of the penis.

*Friday—2 p.m.*

GRANTLEY TAYLOR. Radium needles in cancer of breast.
HORATIO ROGERS. Chronic cystic mastitis.
RICHARD DRESSER. X-ray in the diagnosis of gastro-intestinal cancer.
SHIELDS WARREN. Changes in tumor tissue caused by radiation.
JOHN HODGSON. Treatment of pain in cancer patients.
CARL ERNLUND. Cancer of the antrum.

## MASSACHUSETTS WOMEN'S HOSPITAL

*Thursday*

HENRY T. HUTCHINS—9. Panhysterectomy.
STEPHEN RUSHMORE—9. Plastic laparotomy.
WILLIAM A. WHITE, JR.—9. Laparotomy.
REGINALD MARGESON—9. Transverse cervical Cæsarean section.
ROBERT L. MASON—9. Thyroidectomy.
Staff—2. Dry clinic. CHARLES H. LAWRENCE: Endocrine sterility, end-results. DONALD MACOMBER: Problems of sterility. CHARLES F. PAINTER: Congenital obturator dislocation of right hip; causes of eburnation of bone. J. STEWART ROONEY: Pathological specimens.

## CHELSEA MEMORIAL HOSPITAL

*Thursday*

Staff—9. Dry clinic. CHARLES P. SHELDON: Septic abortions. LLEWELLYN H. ROCKWELL: Perforated duodenal ulcer. GEORGE A. MARKS: Acute appendicitis with peritonitis. SYLVESTER B. KELLEY: Causes of death in prostatitis.
Staff—2. General surgical operations.
Staff—2. Dry clinic. GORDON MORRISON: Abdominal trauma. G. STEPHEN JONES: Volkmann's contracture. ALEXANDER P. AITKEN: Epiphyseal separation of the radius. JOHN S. HODGSON: Fractures of the skull. Discussion by FREDERICK J. COTTON.

## CAMBRIDGE HOSPITAL

*Tuesday*

Staff—9. General surgical clinic.
Staff—2. General surgery, dry clinic.

*Wednesday*

J. W. SEVER and associates—9. Fracture clinic.
V. H. KAZANJIAN—9. Corrective fracture clinic.
Staff—2. Fractures, dry clinic.

## SYMMES ARLINGTON HOSPITAL

*Tuesday*

F. J. COTTON—9. Bone and joint surgery.
A. L. BRETT—9. Tumor of the spinal cord; shoulder arthrodesis.
G. P. TOWLE—9. General surgery.
S. G. JONES—9. Volkmann's paralysis.

## SURGERY OF THE EAR, NOSE AND THROAT

### MONDAY

H. DAVIS, H. A. DERBYSHIRE and M. H. LURIE—Harvard Medical School, Bldg. C—3. Physiological experiments on the hearing of animals with the technique first reported by Wever and Bray; report of the pathological conditions found in animals with abnormal hearing, demonstrating technique and apparatus used; physiological experiment conducted on animal with the apparatus used, demonstrating; (1) auditory response obtained from the cochlea itself; (2) auditory response from the cochlear nerve and its various ganglion centers in the midbrain; (3) auditory response as obtained from the cortex of the animal in the temporal lobe; (4) the effect of anæsthetics on these electrical responses; (5) demonstration of masking of tones in the cochlea.

F. E. GARLAND—Harvard Medical School, Bldg. B. Demonstration of historical instruments.

### TUESDAY

Staff—Massachusetts Eye and Ear Infirmary—9. Operations and demonstration of cases.

WALTER B. HOOVER—New England Deaconess Hospital—9. Osteoma of sinuses; laryngeal and tracheal complications of thyroid surgery; lingual tonsils and lateral bands of pharyngeal lymphoid tissue; syndrome of anæmia, glossitis and dysphasia.

J. W. ROCKETT and T. E. DINAN—Cambridge City Hospital—9. Tonsillectomies with gas-oxygen anæsthesia; presentation of cases of lateral sinus thrombosis.

F. G. MINITER and associates—Carney Hospital—9. Operation and demonstration of cases.

WILLIAM T. HALEY—St. Elizabeth's Hospital—11. Operation for correction of dislocation of nasal septum.

H. P. MOSHER—Harvard Medical School, Bldg. B—2. Exhibition of anatomical casts demonstrating the anatomy of the nose and throat; discussion of teaching methods; demonstration on the cadaver of the submaxillary approach for deep pus in the neck. P. E. MELTZER and M. H. LURIE: Exhibition of specimens illustrating the anatomy of the ear.

Staff—Beth Israel Hospital—2. L. M. FREEDMAN: Experiences with vocal cord paralysis in thyroidectomy. D. J. FINE: Technique for relief of bilateral recurrent nerve injury. CHARLES GETTES: Studies on galvanism in vestibular tests. L. M. FREEDMAN: Jugular puncture in mastoiditis. S. CLINE: Tuberculous laryngitis and its treatment. S. GARFIN: Treatment of malignant tumors of the upper respiratory tract. L. M. FREEDMAN: Bronchoscopic studies.

F. E. GARLAND—Harvard Medical School, Bldg. B. Demonstration of historical instruments.

### WEDNESDAY

Staff—Massachusetts Eye and Ear Infirmary—9. Operations and demonstration of cases.

WALTER B. HOOVER—New England Deaconess Hospital—9. Operations.

HARRY J. INGLIS and associates—Boston Dispensary—9. Dry clinic. LOUIS WOLFSON: Bronchoscopy in the upright position as an out-patient procedure. A. I. COHEN, F. S. DUSHAN and FRANCIS STERN: An improved method of skin testing in allergic disturbances of nose and throat.

Staff—Children's Hospital—9. LYMAN RICHARDS: Acute laryngo-tracheo bronchitis. MAURICE EVANS: Bilateral jugular ligation and its neurological complications. PHILIP MYSEL: Cerebral abscess. CHESTER MILLS: Sinusitis. JOSIAH E. QUINCY: Radical mastoid operation. CHARLES ALLMAN: Unusual foreign bodies. ELMER GILLESPIE: Complications in simple mastoidectomy. SAMUEL CLINE: Cases of sinus thrombosis.

F. G. MINITER and associates—Carney Hospital—9. Operations and demonstration of cases.

JOHN BURNS—St. Elizabeth's Hospital—11. Radical sinus operation under nerve block.

F. E. GARLAND—Harvard Medical School, Bldg. B. Demonstration of historical instruments.

### THURSDAY

Staff—Massachusetts Eye and Ear Infirmary—9. Operations and demonstration of cases.

WALTER B. HOOVER—New England Baptist Hospital—9. Operations.

E. J. BUTLER and C. H. ALLMAN—Cambridge Hospital—9. Operative and dry clinic. Hematogenous infection of left mastoid with extradural abscess in a nine months old child; pneumococcus type III meningitis with labyrinthitis, demonstration of case.

F. G. MINITER and associates—Carney Hospital—9. Operations and demonstration of cases.

C. FAUNCE—Faulkner Hospital—11. Operations and demonstration of cases.

WILLIAM T. HALEY—St. Elizabeth's Hospital—11. Radical operation for maxillary antrum.

JOHN BURNS—St. Elizabeth's Hospital—11. Radical mastoid operation.

F. E. GARLAND—Harvard Medical School, Bldg. B. Demonstration of historical instruments.

### FRIDAY

Staff—Massachusetts Eye and Ear Infirmary—9. Operations and demonstration of cases.

WALTER B. HOOVER—New England Deaconess Hospital—9. Operations.

F. G. MINITER and associates—Carney Hospital—9. Operations and demonstration of cases.

Staff—Massachusetts Eye and Ear Infirmary—2. Dry clinic. H. P. CAHILL: The present status of brain abscess from the standpoint of the otologist. P. E. MELTZER: A twelve year summary of cases of lateral sinus thrombosis at the Infirmary. P. MYSEL: A ten year review of cases of labyrinthitis at the Infirmary. D. C. SMYTH: Chest cases requiring bronchoscopy, lantern slide demonstration. A. S. MACMILLAN and D. C. SMYTH: The accessory sinuses from the standpoint of the roentgenologist and the clinician. A. S. MACMILLAN: Petrositis from the X-ray standpoint. G. H. POIRIER: Result of the Mosher-Toti tear sac operation. M. H. LURIE: Histological slides showing the pathological condition of the internal ear. E. W. HERMAN: Radium and X-ray treatment of cancer of the larynx. H. P. MOSHER: Notes on œsophageal cases. F. E. GARLAND: Surgery of the submaxillary gland. C. G. PAGE: Fungi in tracheal and bronchial mucous. G. L. TOBEY, JR.: The Tobey-Ayer test.

F. E. GARLAND—Harvard Medical School, Bldg. B. Demonstration of historical instruments.

*Days to be announced*

ISABELLA D. KERR—New England Hospital for Women and Children. The use of avertin anæsthesia in tonsillectomies.

MARGARET NOYES KLEINERT—New England Hospital for Women and Children. Mastoidectomies in infants.

L. F. JOHNSON—Massachusetts Memorial Hospital. Bronchoscopic operative clinic.

C. W. BUSH, R. O. PARRIS and B. N. WEIN—Massachusetts Memorial Hospital. Operations.

H. L. BABCOCK—Massachusetts Memorial Hospital. Otological problems in contagious diseases.

A. W. ROWE and D. W. DRURY—Massachusetts Memorial Hospital. Endocrine factors in deafness.

OLIVER A. LOTHROP—Newton Hospital. Tonsil, sinus and septum operations; reduction of recent fractures of the malar and nasal bones; discussion of the indications for mastoid and sinus surgery.

CHARLES I. JOHNSON, DONALD H. MACDONALD and EDGAR M. HOLMES—Newton Hospital. Operations and demonstration of cases.

## SURGERY OF THE EYE

### MONDAY

Staff—Massachusetts Eye and Ear Infirmary—2. Operations.

VIRGIL G. CASTEN—Massachusetts Eye and Ear Infirmary—2. Visual fields in neurological cases.

T. L. TERRY—Massachusetts Eye and Ear Infirmary—2. Pathological demonstration.

J. H. WAITE and associate—New England Deaconess Hospital—2. The eye in diabetes.

J. J. REGAN, SOMA WEISS and DONALD MUNRO—Boston City Hospital—3:10. The eye in arteriosclerosis, hypertension and tumor.

### TUESDAY

H. B. C. RIEMER and assistant—Massachusetts Eye and Ear Infirmary—9. Operations.

DR. BEDELL—Massachusetts Eye and Ear Infirmary—9. Technique of photographing the fundus.

F. H. VERHOEFF and assistant—Massachusetts Eye and Ear Infirmary—9. Operations and demonstration of cases.

WILLIAM D. ROWLAND—Massachusetts Memorial Hospital—9. Operations.

EDWARD D. HURLEY and associates—Carney Hospital—9. Operations and demonstration of cases.

PETER MCADAMS—St. Elizabeth's Hospital—11. Operations.

J. H. WAITE and associate—New England Deaconess Hospital—2. The eye in thyroid.

V. G. CASTEN—Long Island Hospital—2. Operations.

### WEDNESDAY

J. HERBERT WAITE and assistant—Massachusetts Eye and Ear Infirmary—9. Operations.

DR. BEDELL—Massachusetts Eye and Ear Infirmary—9. Technique of photographing the fundus.

F. H. VERHOEFF and assistant—Massachusetts Eye and Ear Infirmary—9. Operations and demonstration of cases.

Staff—Boston Dispensary—9. The eye and syphilis.

EDWARD D. HURLEY and associates—Carney Hospital—9. Operations and demonstration of cases.

HUGH DONAHUE—St. Elizabeth's Hospital—11. Operation for cataract.

ALLEN GREENWOOD—Massachusetts Eye and Ear Infirmary—2. Fundus cases.

T. L. TERRY—Massachusetts Eye and Ear Infirmary—2. Pathological demonstration.

Staff—Massachusetts Eye and Ear Infirmary—2. Operations; motion pictures.

### THURSDAY

EDWARD K. ELLIS and assistant—Massachusetts Eye and Ear Infirmary—9. Operations.

H. B. C. RIEMER—Massachusetts Eye and Ear Infirmary—9. External diseases of the eye.

EDWARD D. HURLEY and associates—Carney Hospital—9. Operations and demonstration of cases.

DRS. LIEBMAN and SACHS—Beth Israel Hospital—10. Cataract extraction, muscle advancement, demonstration of cases.

J. J. DUNPHY—Massachusetts Eye and Ear Infirmary—2. Traumatic injuries, methods of treatment and results.

Staff—Massachusetts Memorial Hospital—2. Operations and demonstration of cases.

J. J. REGAN and DONALD MUNRO—Boston City Hospital—2. Neurological cases, dry clinic.

### FRIDAY

W. HOLBROOK LOWELL and assistant—Massachusetts Eye and Ear Infirmary—9. Operations.

DR. MCCARTHY—Massachusetts Eye and Ear Infirmary—9. Color vision testing.

J. J. REGAN and staff—Boston City Hospital—9. Operations.

EDWARD D. HURLEY and associates—Carney Hospital—9. Operations and demonstration of cases.

VIRGIL G. CASTEN—Massachusetts Eye and Ear Infirmary—2. Ocular paralysis in neurological cases.

T. L. TERRY—Massachusetts Eye and Ear Infirmary—2. Pathological demonstration.

Staff—Massachusetts Eye and Ear Infirmary—2. Operations.

J. J. REGAN and WILLIAM B. CASTLE—Boston City Hospital—2. The eye in anæmic patients.